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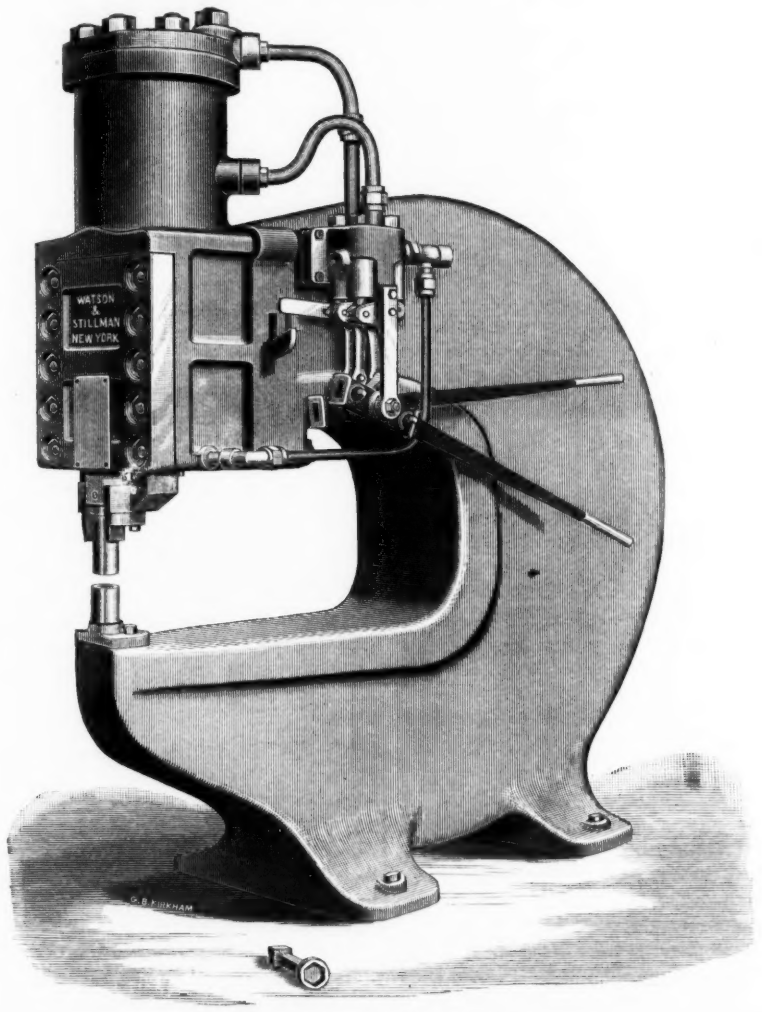
Hydraulic Ship Builders' Tools.

We give on this page illustrations of two machines specially designed for the use of builders of steel or iron vessels.

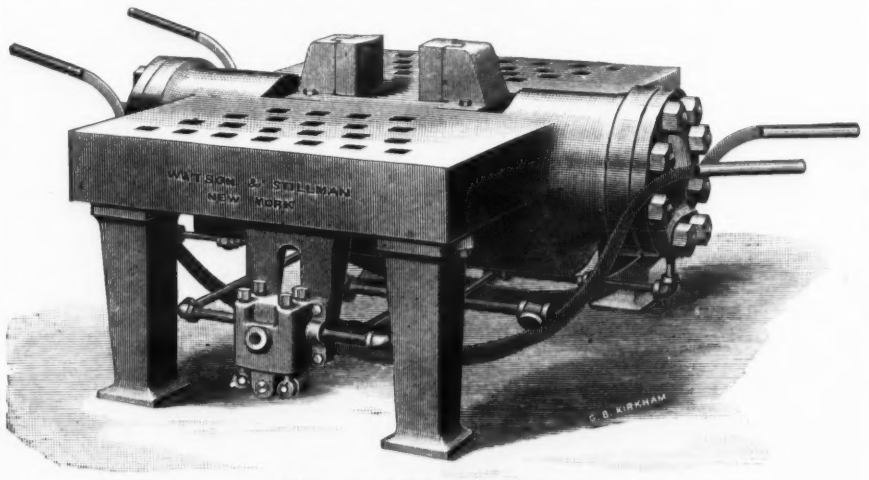
The first of them is a hydraulic riveting machine, designed originally for riveting up ship frames, and for that purpose has a double-acting cylinder, one ram connected with a compressor for tightening the plates, and the other for setting the rivet. In the cut the upper pipe connects with the cylinder at a point above the riveting ram. The lower pipe, which is connected up to the piping outside of the governing valve, and in direct connection with the accumulator, connects with small cylinders, three in number, situated in a small block at the lower end of the guide, one of which returns the riveting ram, the other two returning the compressor ram. The small lever shown projecting from the side of the machine is connected with the riveting ram in such a way that the dies, in case nothing is interposed, will not come together and be marred, as would be the case if they should strike, since the temper of such dies is soon drawn where hot rivets are used. The machine has a stroke of five inches for each of the rams, and the rivet die is guided by the compressor, instead of being open as shown in the cut for illustration. Two levers are used for the complete manipulation of the tool, one of them throwing the accumulator pressure onto the compressor ram, the other on the riveting ram, and each of them working under a total pressure of about twenty tons, with an accumulator pressure of 1,500 pounds to square inch. The release of the accumulator pressure upon the compressor ram allows that much additional pressure to be exerted upon the riveting ram, making a total of about forty tons for finishing the head of the rivet. In operation it is found that the two levers may be brought down together, and that the compressor ram will travel sufficiently fast to get the plates close before rivet dies strike the end of the rivet. The operated valves are metal-seated, with passages not easily described, connecting the four valves. The hydraulic cylinders of this tool are made to be taken off from the body of the machine, so that there will be a certain interchangeability of heads upon different size machines of the same capacity. The front face of the machine is made almost flush with the rivet dies, so that any work may be placed directly in front of it, and riveting done on the angle iron, which is backed by a flat plate.

The second machine is for bending the bars for ship frames, and is made in two sizes, Nos. 1 and 2, the latter being the one illustrated.

This tool is capable of bending a "Z" bar as large as 8″x3″ in the direction of its greatest depth, with a water pressure of 300 pounds per square inch. The table is 3x4 feet 6 inches, with four rows of square holes two inches square, seven holes in the outer row, four in the inner. The cylinders are eight inches in diameter, and have a stroke of four inches. The ram is continuous from one cylinder into the other, and with a center bearing. The bending blocks are dovetailed into a double-headed saddle, which is firmly attached to the ram, and slides in grooves, which are covered to prevent the scale from dropping upon them. There are also covers to prevent the scale blowing onto the surface of the ram, and finding its way into the cylinder itself, and cutting it. The oil holes are provided with screw plugs which prevent the dirt reaching the slide. Both heads of the cylinders are removable, and provided with air passages for allowing the air to be driven out, or to drain the water or fluid from them in case it is desired in cold weather. The valves are placed in one body, and a lever at each corner of the press governs the motion completely, opening the release valve for one cylinder when pressure valve is opened for the other, and the motion is automatically stopped by the taking of the hand from the lever, so that there is no liability of the press beginning motion or continuing, except some one is handling the valve. This machine, complete, weighs about 5,000 pounds. The same description applies to the No. 1 machine, except that it has cylinders 7″ diameter, 12″ stroke, and is capable of bending a 6″x3″ "Z" bar in the direction of its greatest depth with blocks three feet apart.



HYDRAULIC RIVETING MACHINE.



HYDRAULIC BENDING MACHINE.

These machines are built by Watson & Stillman, New York City.

There was a proposition before the American Society of Mechanical Engineers at the Richmond meeting looking to the preparation and publication of an engineers' reference book, or something of the kind. We do not know what the final action on this matter will be, but we predict that if the job is ever undertaken it will be found a big one. It would be about all one man could do, if unhampered, to make and keep before the public, properly revised, in accordance with the every-day advance in knowledge, such a book. A thousand men, a majority of whom must agree in the matter, would, we fear, find the task beyond their abilities. Engineers use a variety of reference books, one for some special purpose and another for another purpose, according to their faith. And we have no doubt they will continue to do so.

The Supreme Court of the State of Texas has recently decided a case which has an important bearing on the matter of "black-listing" men by railroad companies. A man named Behee, who was formerly employed by the Missouri Pacific Railroad, was discharged for alleged incompetency, and at the same time was black-listed, so that he could not obtain employment on any of the roads of Texas. He brought suit for damages, and was defeated in the lower court, but on appeal to the higher court was awarded $10,000 damages.

Where a man has been employed by a railroad company, and has clearly shown that he is incompetent, and therefore liable to cause loss of life and property, it would certainly be a good thing if, by some means, other roads could be spared the trouble and responsibility of also making a trial of him to again demonstrate his incompetency, especially as this demonstration is liable to cause loss of property by the road, and of the lives of fellow employes or passengers. Black-listing, if it were only employed in the case of men who were clearly and indisputably incompetent for railroad service, would accomplish this object, and would result in substantial justice being done. But as it has been carried on, it has resulted in a great deal of injustice and undeserved hardship. Men who have offended the officers of roads in some way for which they were not in the least to blame, have in many cases, by the operation of the black-list, been prevented from obtaining positions by which they could obtain an honest living. We suppose that where a man has shown clearly that he is mentally or physically unfitted for service on a road, and that it is therefore dangerous to employ him on one, the courts would uphold the roads in protecting themselves against him; but it is a good thing that it has been by this decision shown that the black-list if used at all must be used with great care, and for good and sufficient reasons, not on account of the whims of any one, nor his personal spites

The Board of Aldermen of New York have passed a vote, 14 to 11, to permit the construction of a tunnel under Forty-second street, to connect with Long Island. This was supposed to be upon the application of the New York & Long Island Railroad Company, but just now it is difficult to find who proposes to build the tunnel, as those who were believed to be interested in the matter disclaim any such interest. The City of New York is to receive three per cent. of the gross receipts.

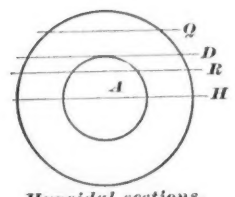
Odontics, or the Theory and Practice of the Teeth of Gears.

BY GEO. B. GRANT.

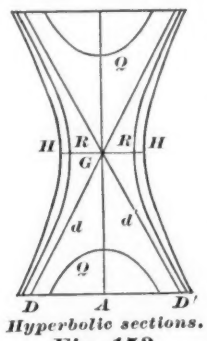
EIGHTEENTH PAPER.

170.—THE SKEW BEVEL GEAR.

When a pair of shafts are not parallel, and do not intersect, they are said to be askew with each other, and they may be connected



Hypoidal sections.
Fig. 152.



Hyperbolic sections.
Fig. 153.

by a pair of skew bevel gears, having straight teeth, which bear on each other along a straight line. Such gears are to be carefully distinguished from spiral gears, used for the same purpose but having spiral teeth bearing on each other at a single point only.

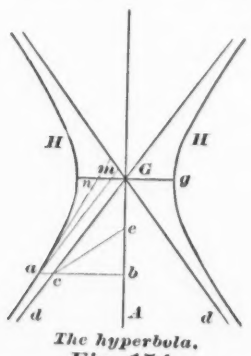
We will endeavor to describe the skew bevel gear so that its general nature can be understood, but it is impossible to do so in simple language. It is the most difficult object connected with the subject. The theory cannot even be considered as yet settled, for writers upon theoretical mechanism do not agree upon it, and there are points yet in controversy.

In the theory of the bevel gear the surface of reference is the spherical surface upon which the tooth outlines are drawn, and upon which the laws of their action may be studied, for spheres of reference of two separate gears may be made to coincide so that the lines upon one will come in contact with those upon the other. For the spur gear, the spheres become planes and the process is the same. But for the skew bevel gear there is no analogous process, for it is impossible to imagine a surface of such a nature that it can be made to coincide with a similar surface when both are attached to revolving askew shafts. There are spiral surfaces which will approximately coincide, and are analogous to the Tredgold tangent cones of bevel gears (161), but any tooth action developed upon such approximate surfaces must, of necessity, be not only approximate, but also very difficult to define and formulate.

Of all the skew tooth surfaces that have been proposed, there is but one, the Olivier involute spiraloid, that can be proved to be theoretically correct.

171.—THE HYPOID.

The pitch surface of the skew bevel gear is the surface known as the "hyperboloid of revolution," and it is so intimately connected



The hyperbola.
Fig. 154.

with the subject that it must be thoroughly understood before going further. The clumsy name may be abbreviated to "hypoid."

If a line D, Figs. 152 and 153, called a generatrix, is attached to a revolving shaft A, so that it revolves with it, it will develop or "sweep up" the hypoid H in the space surrounding the shaft. A section of the surface by any plane normal to the axis is a circle. The common normal to the generatrix and the axis is the gorge radius G, and a circular section through that line is the gorge circle. A section by a plane d, Fig. 152, parallel to the axis, at the gorge distance from the axis, will be the pair of straight lines d and d', Fig. 153, either one of which is an element of the surface, and will form it if used as a generatrix. A section by any other plane parallel to the axis will be a hyperbola, to which the elements d and d' are assymptotes, or lines which the curves continually approach, but never reach. Fig. 153 shows at Q the hyperbolas cut by the plane Q of Fig. 152, and at R those cut by the plane R. The principal hyperbola H is the only one with which we are concerned.

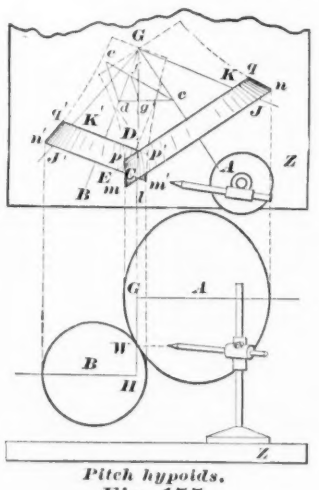
The hypoid is best studied as projected upon a plane parallel to the axis, as in Fig. 154, in which A is the projection of the axis, d is that of the generatrix, dGA is the skew angle, and H is the principal hyperbola.

When the skew angle and the gorge radius are given, the hyperbola is easily constructed by points. Any line ab is drawn normal to the axis and the gorge distance $be = Gg$ is laid off from b, the distance ab is made equal to ec, and a is then a point on the curve. The curve is to be drawn through several points thus constructed.

To draw a tangent to the curve at any point a, draw a line am parallel to the assymptote d, lay off mn equal to Gm, and draw the tangent an.

172.—THE PITCH HYPOIDS.

The utility of the hypoid as the pitch surface of the skew gear depends upon the peculiar property that any number of such surfaces will roll together, and drive each



Pitch hypoids.
Fig. 155.

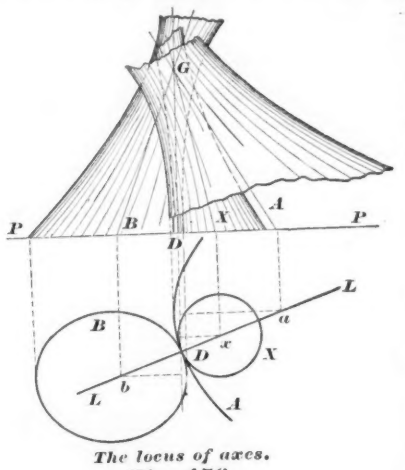
other by frictional contact with velocity ratios in the proportions of the sines of their skew angles, if their gorge radii are in the proportions of the tangents of their skew angles.

It is required to construct a pair of rolling hypoids that will transmit a given velocity ratio between two shafts that are set at a given angle with each other. In Fig. 155, A and B are the given axes, and AGB the given shaft angle. The directrix D is to be so drawn that the sines of the skew angles AGD and BGD are in the proportion of the given velocity ratio, and this is best done by drawing lines parallel to the axes, at distances from G that are in the given ratio, and drawing the directrix through their intersection D.

In the figure the axes are situated one over the other at a distance GH called the gorge distance, and the directrix D is situated between them so as to pass through the gorge line and divide the gorge distance into gorge radii, GW and HW, which are in proportion to the tangents of the skew angles. This is best done by drawing cd normal to GD in any convenient position, laying off the gorge distance ce at any convenient angle with cd, and drawing de and gf parallel to it; ef will be the gorge radius GW for the axis GA, and fe will be the gorge radius HW for the axis GB.

Then, if the directrix, thus situated, is attached first to one shaft and then to the other, and used as a generatrix, it will sweep up a pair of pitch hypoids that will be in contact at the directrix, and which will roll on each other.

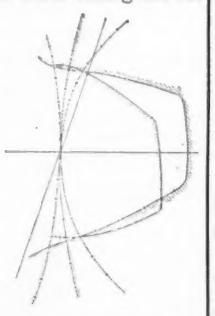
They will not only roll on each other in contact at the directrix, but they will also have a sliding motion on each other along



The locus of axes.
Fig. 156.

that line, the two motions combining to form a resulting motion that must be seen to be understood. It is this sliding motion that makes all the difficulty in the construction of the teeth, for they must be so constructed as to allow it. It is also the cause of the great inefficiency of such teeth in action, for any possible form must have a lateral sliding motion, with the consequent friction and destruction.

If we draw two diameters mn and $m'n'$ through the same point C on the directrix, they will be the diameters of circles that will touch each other while revolving, and may be called pitch circles. If they are thin, and provided with teeth in the given velocity ratio, they will drive each other with a contact that is approximately correct, and if there are several pairs of such thin gears set so far apart that they do not interfere with each other, they will serve light practical purposes fairly well.

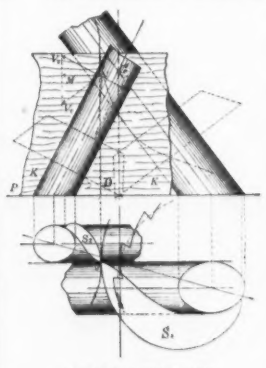

Cycloidal tooth Curves
Fig. 157.

If a face distance CE is laid off on the directrix and another pair of pitch circles constructed, the frustra of the hypoids included between the circles may be called pitch frustra, and they will roll together in contact at the directrix.

It is to be noticed that the pitch diameters thus determined are not, as in spur and bevel gearing, in the inverse proportion of the velocity ratio of the axes, and therefore if one diameter of a pair of skew gears to have a given velocity ratio is given, the other must be constructed. When the skew angles are equal, the pitch diameters are equal, but otherwise the proportion cannot be expressed in simple terms, and must be determined by making the drawing.

173.—THE LOCUS OF AXES.

The rolling hypoids may be examined from another and most interesting point of view. In Fig. 156 the gorge line G is normal, and the directrix D is parallel to the plane of the figure. The plane P is normal to the directrix, and below is a front view of it. On the plane P draw any straight line L through the directrix. From any two points a and b on this line draw lines A and B normal to the gorge line G, and they will be axes of pitch hypoids that will roll on each other in contact at the directrix.



Involute tooth action
Fig. 158.

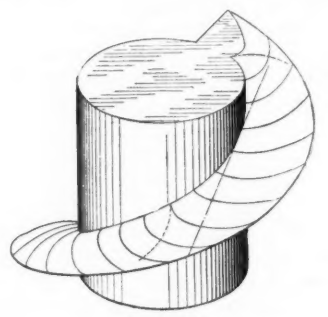
Axes drawn from all points of the line L will form a continuous surface called a "hyperbolic paraboloid," which will be the locus of all the axes of a set of hypoids that will roll together collectively in contact at the directrix.

174.—CYCLOIDAL TEETH FOR SKEW GEARS.

As any number of hypoids, on axes in the same locus of axes, will roll together in either external or internal contact at the directrix, it might be supposed that a tooth similar to the cycloidal tooth for bevel and spur gears might be formed by an element in an auxiliary hypoid X, Fig. 156, which rolls inside of one and outside of the other pitch hypoid.

This is such a plausible supposition that it long passed for the truth, not only with its inventor, the celebrated Professor Willis, but with many other prominent writers, until shown by MacCord to be wrong. It serves to illustrate the confusion in which the whole subject has been and now is.

The tooth surfaces which Willis supposed to be tangent at the generating element of the auxiliary hypoid really intersect at that line, and Fig. 157 shows a pair of such intersecting teeth. The curves of the figure were drawn by an instrument made for the purpose, and are, therefore, a better proof of the intersection of the surfaces than solid teeth would be.

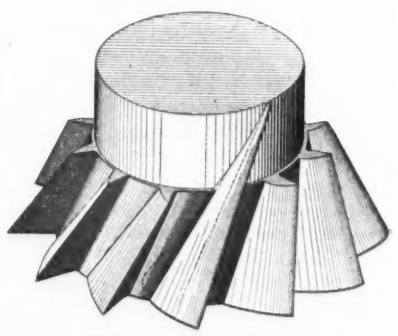

A spiraloid
Fig. 159.

The cycloidal tooth is examined at considerable length, and the instrumental proof of its failure is given in the AMERICAN MACHINIST for September 5th, 1889.

175.—INVOLUTE TEETH FOR SKEW BEVEL GEARS.

Herrmann's form of the Olivier spiraloidal tooth is constructed with the directrix of (172) as a generatrix, as follows:

Suppose that cylinders are constructed upon the gorge circles of a pair of pitch hypoids, Fig. 158, and suppose a plane K to be placed between them. This plane will be tangent to both cylinders, and will contain the directrix, and if moved will move the cylinders as if by friction. Then imagine the plane to move in a direction normal to the directrix, and it will carry that directrix with it as a generatrix always parallel to its first position. It will sweep up the spiraloid


Olivier Involute skew Bevel Gear
Fig. 160.

tooth surfaces S_1 and S_2 imperfectly shown by the figure, or by Fig. 159, and they will be correct tooth surfaces always in tangent contact.

Fig. 159 shows a full involute tooth surface or "spiraloid," and Fig. 160 is a full Olivier skew bevel gear.

The particular involute skew tooth above described is not the only possible form, but it has the least possible sliding action, and is, therefore, the best.

If the plane K has a generatrix line at any angles with the axes of the gears, and is moved in a direction at right angles with that line, correct tooth surfaces will be swept up. In fact, any two spiraloids on any two cylinders will work correctly with each other, and therefore any two spiraloidal gears of the same normal pitch will work correctly together.

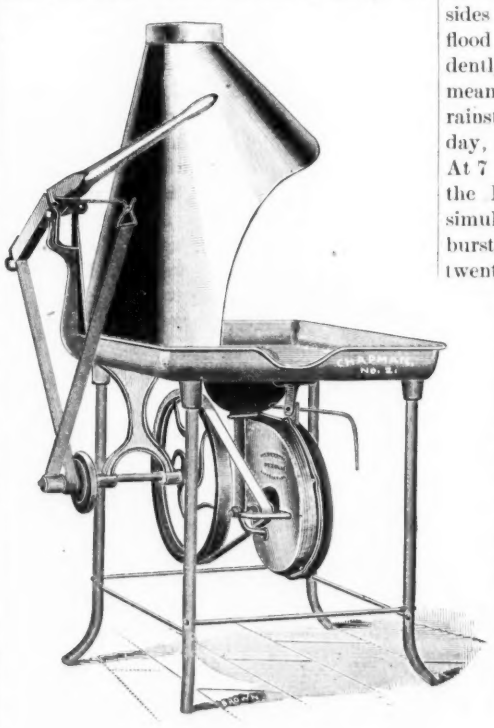
Improved Lever Forge.

Our illustration represents an improved lever forge manufactured by H. L. Chapman, White Pigeon, Mich. This forge has been designed to meet the needs of the general blacksmith and machinist. It is claimed that a heavy grade of work can be speedily and easily done on it, and that, on account of the light and even blast which can be secured with this forge, it is also well adapted for the lightest kind of work.

The legs are made of iron pipe, well braced. They are fastened into the hearth sockets by set-screws, and can be adjusted to suit uneven floors. The bearings for the main shaft are generally made of babbitt metal; but for shafts having a high rotative speed, hard-wood bearings are preferred, as actual tests have shown that these bearings, for this purpose, do not wear as fast as babbitt metal bearings. The hard-wood bearings can be easily renewed at any time. The shaft is made of cold rolled iron, with journals turned and polished. The fly-wheel is heavy, insuring an even blast, and continued motion for some time after the lever has been stopped. The fan has its special features. It is made of an entirely new pattern, and its general design is the result of several years' experiment. The fan has six blades, giving six impulses to the blast during each revolution, so that with a moderate speed a strong blast can be obtained. The tuyere block has a projecting handle, with which the blast is adjusted and the cinders rattled down, which fall into a pit, with a swing door at the bottom for dropping the cinders.

The lever handle has a free side motion; the power is transmitted directly to the fly-wheel shaft by straps and a noiseless friction clutch. Separate views of this clutch are shown in Figs. 1 and 2. It consists of a flanged wheel *B*, fastened to the shaft *A*. A disk wheel *D* works loosely on the shaft *A*. In Fig. 1, part of this disk is shown as broken off, so as to show the internal arrangement of the clutch. A pin *E* projects from the inner surface of the disk, and engages with the sliding block *H*, which works in the slot *I*, cast in the gripping block *G*. The disk *D* also carries a spring *J*, which acts on the end *F* of the gripping block. Hard-wood plugs are driven into the ends of this block, and bear against the inner surface of the flange on the wheel *B*. The plug at *F* can be adjusted by the set-screw *L* to compensate for wear. The action of the clutch will now be easily understood. In turning the disk *D* in the direction as indicated by arrow 1, the pin *E* will move the block *H* in the slot *I* towards the right, thereby breaking the contact between the plug *C* and the flange on the wheel *B*; but at all times the action of the spring *J* keeps the block *F* in contact with the same flange. With this arrangement, the disk *D* can turn freely in the direction of arrow 1, while the wheel turns in the direction of arrow 2. But as soon as the disk *D* ceases to turn in the direction as indicated, the spring *J* will push the block *G* forward, and bring the plug *C* in contact witk the flange, or, in other words, lock the disk and the flange wheel, so that the motion given by the strap to the disk *D*, in a direction opposite to arrow 1, will be transmitted to the wheel *B*, giving to the motion of the latter an additional impulse. This locking arrangement is very positive, and is quickly accomplished without any backward motion. This clutch is not only adapted for driving the fans for the forges, but it may also be used for many other purposes. The clutch is patented.

The forge is simple, strong in construction, and light to handle. The openings in the sides of the hearth are low—a point which carriage smiths or machinists will appreciate. The hood has a collar for a 7-inch pipe.



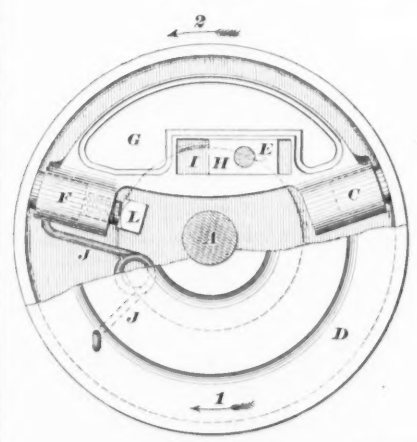


Fig. 1.

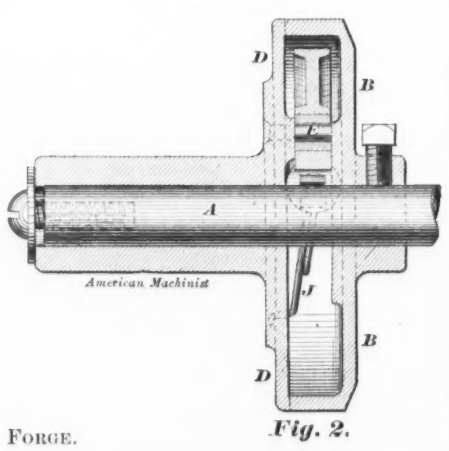


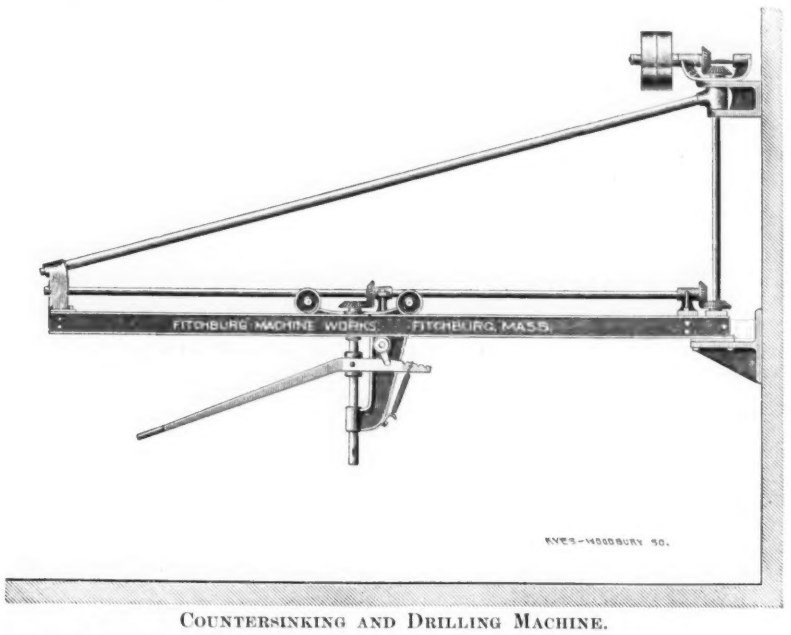
Fig. 2.

LEVER FORGE.

It is understood that the crack steamships—the "Teutonic" and "Majestic," of the White Star line, and the "City of New York" and "City of Paris," of the Inman line, will, next year, be run on different dates instead of on the same dates, as at present. This will greatly improve mail facilities, and will be appreciated by the public.

Countersinking and Drilling Machine.

We give herewith an illustration of a machine built especially for the use of boiler makers, bridge and ship builders, and for all work of a similar nature. It is to be used for drilling and countersinking holes in any large plates of steel or iron, or for beams, and the work remains stationary; the drill being moved back and forth on the arm, or swung into any desired position. The spindle is operated by a lever 5 feet long, which is counterbalanced by the spring as shown, and gives to the spindle a vertical movement of 6 inches. Spindle is of steel 2⅝ inches diameter. The traverse of the head on the arm is 11 feet. The lower end of the spindle when in its highest position is 30 inches from the bottom of the arm, and the distance from the bottom of the arm to the center of the pulley shaft is 6 feet. The arm projects from the wall or post 15 feet 10 inches, and the spindle can be operated at a distance of 3 feet 1½ inches from the wall. The tight and loose pulleys for the driving belt are 18 inches diameter, 4¾ inches face, and are so arranged that they may be turned to a position at right angles to that shown in the cut, if desired. The machine weighs complete 1,800 pounds, and is manufactured by the Fitchburg Machine Works, of Fitchburg, Mass.



COUNTERSINKING AND DRILLING MACHINE.

The Manchester Canal.

It was scarcely to be expected that so great and difficult an undertaking as the construction of the Manchester canal would be carried through without accident. One of the most difficult portions of the work was that upon the Thelwall section, where the canal cuts right through the river Mersey, which has consequently to be dammed up on both sides of it. In the event of any unusual flood the pressure upon the banks would evidently be great, and it is therefore by no means extraordinary that, after so heavy a rainstorm as that on Thursday night and Friday, a catastrophe should have taken place. At 7 o'clock on Friday evening the dam on the Lancashire side gave way, and almost simultaneously that on the Cheshire side also burst, the in-rush of water filling the canal twenty-five feet deep, and rushing along it with irresistible force. It is extraordinary that the loss of life should not, under these circumstances, have been very great, as the works have, in some cases, been carried on night and day. Fortunately, the roar of the water gave a sufficient warning for all save one or two to rush up the sides of the banks; but ten bridges were swept away, the railway bridge alone withstanding the tremendous rush of the water. It is seldom that any great engineering enterprise is carried out without the undertaking being delayed by some unforeseen accident, and the failure of the dams across the Mersey shows that the construction of the Manchester ship canal is to be no exception to the general rule.—*London Standard.*

A proposition is made by Mr T. Howell Williams, of the London City Council, to manufacture the gas used in London at the coal fields and convey it to London by pipe lines. This he concludes would dispense with a great amount of unsightliness and unhealthiness incident to the gas works in London, and waste of area covered by them. He contends that the gas would also be of a better quality, and most of the wastage of long exposure to atmospheric changes avoided.

To the French yachtsmen who proposed sending a yacht to this country to try for the America's cup the *Echo de Paris* gives this in the way of advice: "We have never beaten the English. The English have never beaten the Americans."

Sketches of an Apprenticeship.

BY W. S. ROGERS.

We had an old 36-inch lathe in our shop, used only for turning large iron rolls that didn't have to be very accurate. None of the jours loved that lathe, and there seemed to be a perpetual boycott against it. One day, when the old man was good-humoredly hammering ideas into my head, I suggested that I could run the biggest lathe in the place, and do lots of work if he could trust me. He thought a minute, said he would see, and left me.

The next day, Tom, our foreman, came round and told me to go on the old 36-inch, and turn off those rolls that had come in. "I have chalked the sizes you are to turn them, on each roll, and I am going to let you go ahead until you get stuck, before I help you any," he said, and left me.

To say I was disappointed don't express it. I was thinking of one of those nice, good, clean tools in the front part of the shop, where I could stand by the windows with one eye on the cut, the other out doors, and look real proud, just like an old jour, when I was talking with the old man. Evidently when he told me he "would see," he had, and went one better. While I was getting the old paintless rattle trap in order some of the young jours came round and sympathized with me, telling me to "get on and ride," "don't get caught in the ways," "get a ladder," etc., which didn't mend my lacerated feelings.

At noon, while sharing our lunch together, Johnny and I plotted together to accidentally smash that old lathe. Our plan was, after some debate, to put on such an everlasting big cut that something would break, and keep at it until the old thing was only fit for scrap. We didn't think the old man would care very much, and everybody else in the shop would rejoice over it; besides, it would save my chum from ever being bothered with it. Our plans arranged, after dinner I had the first chunk centered and put in by the laborers—the belt laced so tight I was afraid it would lift the lathe off the floor—the belt feed thrown off and screw feed thrown in, a good round nose in the tool-post, and started. The old lathe groaned and chattered, but instead of breaking out all the teeth in the back gears, or kicking the work out and breaking the centers, as I fondly expected, I only kept breaking off the tool all the afternoon. At last we concluded to take old Joe, the blacksmith, into our plan, and have him forge a tool that would do the work. I explained to Joe, and he said he would make a "buster," and he did. It was a sort of cross between a side tool and a cannon ball—all the depth possible with very little clearance, and backed off way down until the cutting edge was like that of a cheese knife. After I got that tool going, the chips that it *cut* off surprised all of us, and the more feed I put on, the better the old lathe seemed to like it. Johnny and I gave up the breakdown plot in despair, and I got so interested that I had Joe make another tool for me.

Now the old man had often told us the way to succeed as foremen and managers of men was to study their natures, and read their thoughts, and I often wondered if he had not read me pretty thoroughly, and knew the constitution and ability of that old lathe better than both of us. At least the twinkle in his eyes for a week afterwards when near us made us think considerably.

Micrometer Depth Gauge.

We give on this page some illustrations of a new micrometer depth gauge which has been devised by Mr. Carl W. Malmquist, of 265 Lombard street, New Haven, Conn., and upon which he has recently been granted a patent. Figure 1 is a general view of the tool, Fig. 2 a vertical section, and Fig. 3 a view of the main body to which is fitted the micrometer screw and adjusting nut. The body of the tool is split as shown through its threaded portion, and just above the outer thread is tapered to fit the knurled sleeve or nut, which, by being turned, serves to close the internal threads on the screw and take up all play or looseness.

The screw has forty threads to the inch, and the lower extension of it, together with the small bush through which it passes, are provided with the usual micrometer graduations by which the distance that small end of the screw projects beyond the hardened and ground edges of the wings is indicated in thousandths of an inch.

The utility of such a tool to machinists, tool makers, die sinkers and others who have occasion to determine accurately the depth or distance of one surface of their work from some other surface will of course be readily seen. Few of the better class of mechanics are nowadays satisfied to do anything with a possible error of as much as .001", and this tool when well made will enable them to readily make holes or depressions of any kind in dies or other pieces of work within that limit.

Getting the Earth.

If Jay Gould and the Standard Oil Company have really joined hands to take possession of the railroads of this country, there will be no room left in it for anybody else, except, perhaps, the hostile Indians on the reservations.—*Dallas News.*

Well, there is this satisfaction about it, that the stronger the game is worked, the sooner the reaction will come, and then——

A Cincinnati man engaged a truck and four men a few days ago and stole a twelve horse-power steam engine. Neither man nor engine has been found yet. This is not quite up to the case of the woman who was tried at the quarter sessions in this city last year for stealing a two-story brick house.—*Philadelphia Inquirer.*

No, nor to the man who stole a saw-mil and got arrested when stealing the dam.

The line of the Pennsylvania Railroad, from Frankford Creek, on the south, to Poquessing Creek, on the north, at Torresdale, a distance of nearly seven miles, is soon to be lighted by electric lights ranged along at intervals, so that for that distance the tracks will be as light as Chestnut street.

The contract for this latest great feat in modern railroad management for the security of the lives of passengers and employes, and the avoidance of loss by the smashing up of freight trains, has been awarded to the Electric Light and Heating Company, whose great plant at Lardner's Point, near Tacony, is now almost completed, and will, it is said, be in operation before the advent of 1891.

One of the incorporators of the electric light company said yesterday: "We have such a contract, and when, a day or two ago, I called on General Agent Latta, of the Pennsylvania Railroad, to inquire when the railroad company would be ready for us to begin erecting our wires, which will be mainly run on the telegraph poles along the tracks, the answer that I received was: 'We are ready now; go ahead as soon as you like.'

"We have contracted for fifty miles of wire on which to run our lights, and we expect to have every foot of it in place and in use inside the next six months."

The stretch of railroad to be lighted is through a populous district, and has long been noted for the frequency of accidents on it. There is little doubt that the electric lighting will greatly reduce or almost entirely do away with this danger.

It is understood that in time the electric lighting system will be extended along the railroad, and may in time extend all the way between Philadelphia and New York. In this way the track would be made almost as bright as day.—*Philadelphia Record.*

Engines for the New Gunboat "Concord."

The accompanying illustrations (page 5) show the engines in the new gunboat "Concord," whose trial trip was noticed in our issue of Nov. 27. The engines are of the horizontal direct-acting triple-expansion type. Each engine has a high, intermediate, and low-pressure cylinder, of 22, 31 and 50 inches diameter respectively, and a piston stroke of 30 inches. The engines are placed in separate water-tight compartments, the low-pressure cylinder being forward in the forward compartment, and aft in the after compartment, the forward engine turning the port propeller.

The main steam valves are of the piston type, one for the high pressure, one for the intermediate, and two for each low-pressure cylinder worked by radial valve gear, and arranged for a minimum cut-off of 0.4 of the stroke in the high-pressure, and 0.5 of the stroke in the intermediate and low-pressure cylinders.

The castings containing the crank-shaft bearing are cast in one piece for each engine, and are bolted to the engine keelsons, and stayed to cylinders by steel tie rods and the guides.

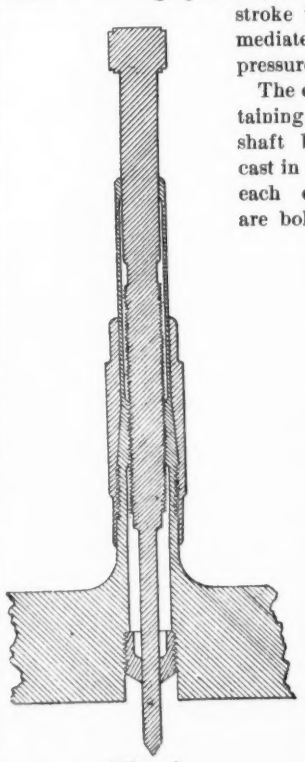


Fig. 2.

Fig. 3.

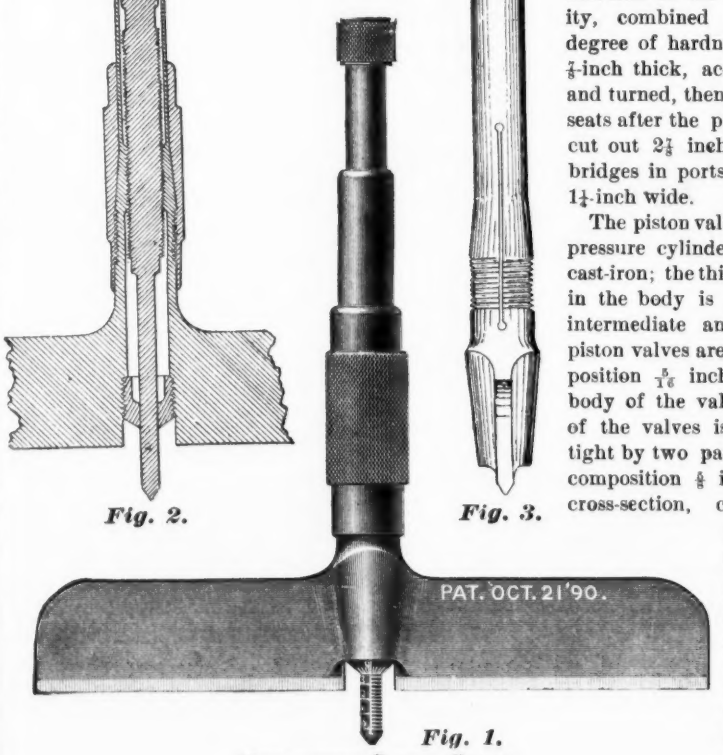


Fig. 1.

MICROMETER DEPTH GAUGE.

A centrifugal pump, driven by an independent engine, is placed in the forward engine-room, and is arranged for freeing the ship from water in case of necessity.

The air, circulating and bilge pumps are driven independently of the main engine, and arranged with bilge as well as sea injection. The air pump delivers into a feed tank of boiler-iron, placed in the forward engine compartment. This tank has a capacity of 300 gallons, and is partitioned and fitted as a filter.

There are two vertical duplex pumps placed in each fire-room for feeding the boilers. One set in each fire-room is fitted to draw from feed-water tank and bottom of forward condenser, and discharge into the boiler. The second set in each fire-room is fitted to draw water from tank, sea, bilge and boilers, and to discharge into fire main, through boiler checks and overboard. The pump in forward fire-room also discharges through distiller. An auxiliary pump of 200 gallons capacity per minute is placed in each engine-room, and fitted to draw water from the sea and bilge, and discharge into the fire main and through outboard delivery.

There are four cylindrical horizontal tubular boilers, containing an aggregate grate surface of 220 square feet, arranged fore and aft, in two water-tight compartments, each with a fire room athwartship, one abaft the after boilers, and one forward of the forward boilers. The width of the fire-room is 8 feet. Both fire-rooms are arranged to work under air pressure when required, and each is fitted with two blowers, capable of supplying continuously, with ease, sufficient air for the required horse-power.

The cylinder casings, which include the steam and exhaust ports and passages, inboard heads, valve chests and sole plate, are fitted with cylinder linings of hard cast-iron. The cylinder casings have an extension cast on them with flanges 1½ inches thick for securing them to engine seatings.

The receivers consist of the spaces between the high-pressure and intermediate, and intermediate and low-pressure piston valves and their connecting pipes. There is a 2½-inch copper pipe, with composition stop valve connecting the main steam pipe to each receiver space, and a composition safety valve with nickel seat of 2 inches diameter on each receiver. The intermediate pressure is weighted to 80 pounds per square inch above the atmosphere, and the low pressure to 30 pounds.

The cylinder heads are cast solid with cylinder casings and stiffened by ribs. The cylinder covers are made of the best cast-steel and ribbed, of the same thickness as the cylinder heads.

The valve liners are made of cast-iron of the toughest quality, combined with suitable degree of hardness. They are ⅞-inch thick, accurately bored and turned, then forced into the seats after the ports have been cut out 2¾ inches wide. The bridges in ports are 1 inch and 1¼-inch wide.

The piston valve of the high-pressure cylinder is made of cast-iron; the thickness of metal in the body is $\frac{7}{16}$ inch. The intermediate and low-pressure piston valves are made of composition $\frac{5}{16}$ inch thick in the body of the valve. Each end of the valves is made steam-tight by two packing rings of composition ⅝ inch square in cross-section, cut obliquely, and tongued and held in place by a composition follower and wrought-iron bolts. The distance pieces for separating the packing rings at each end of the valves are made of cast-iron for the high-pressure, and of composition for the intermediate and low-pressure valves.

The main valve stems are made of steel 1½ inch diameter where they pass through the valves, and 2 inches diameter in the stuffing-boxes.

The main steam throttle for each high-pressure cylinder consists of a disk valve, 8 inches diameter of opening, and closing against the steam pressure in the steam pipe, and is operated by a suitable gear, with hand lever placed adjacent to hand lever of steam reversing gear.

The valve gear is of the radial type. The cut-offs of all cylinders are capable of being adjusted independent of each other. Each reversing arm is carried in bearings rising from the top of the corresponding crank-shaft bearing, with its main center line parallel to the axis of the crank-shaft, and in the same vertical plane. The reversing arm, with its journal, is made of cast-steel. A forged steel pin is secured in the free end of the arm to engage with the radius link. Each radius link engages at one end with this pin, and at the other with the lower pin in the eccentric lever. Each valve connecting rod engages at one end with the corresponding pin in the eccentric lever, and at the other end with a pin in an arm on the valve motion rock-shaft of the low pressure, and direct with the valve stem of high and intermediate pressure cylinders.

The low-pressure valve motion rock-shafts are carried in bearings bolted to the cylinder casings, and have arms set at suitable inclinations to each other, by which the motion is transmitted to the valve stems by links.

The radius links, valve connecting rods and valve links are forged of mild steel.

Each engine has a steam reversing gear, and a hand reversing gear which is conveniently placed on the working platform.

The pistons are made of steel, the thickness of metal is 2¼ inches at the center and 1⅜ inches at the periphery; that around the eye of the piston rods is 1⅜ inch. Each piston has a cast-iron wearing shoe upon which it rests. These shoes are so fitted that they can be adjusted to take the wear. The packing rings are ¾ inch thick, ⅝ inch wide, and adjusted by steel springs. The followers are 1¼ inch thick, and secured in place by six steel bolts for the high, seven for the intermediate, and ten for the low-pressure piston, all one inch diameter.

The piston rods, one to each cylinder, are made of steel, 3¾ inches diameter, fitted and secured to pistons by nuts; the piston rod is also secured in crosshead by nuts. Metallic packing is used in the stuffing-boxes.

The tie-rods, securing the cylinders to pillow-block frames, are made of steel, turned to a diameter of 3¼ inches. They have T heads forged on each end, and secured to pillow blocks and cylinders by steel bolts 2¼ inches diameter.

The crossheads are made of steel, finished all over, and fitted with cast-iron slippers, lined with white metal 12 inches wide and 15½ inches long. The connecting rod journals are 4½ inches diameter and 5¾ inches long. The crosshead slides are made of steel. The connecting rods are made of wrought-iron finished all over. They are 64 inches long between centers, 4½ inches diameter at neck of crank-pin end, and 3¾ inches diameter of neck at crosshead end. The crank-pin and crosshead boxes are made of composition. The crank-pin boxes are secured to rod by two 2¾-inch wrought-iron bolts, and each crosshead box, by two 2¼-inch bolts. The nuts are secured by set-screws. The boxes for crank-pins are 1⅜ inch thick, and for crosshead 1 inch thick.

The crank-shafts are forged of mild steel built up with cranks at equal angles with each other. The crank webs are 6½ inches thick, except the after one of each engine, which is 7¼ inches thick. The metal in the eyes of the webs is 3⅜ inches thick at the crank-pin ends, and 4½ inches at the shaft ends. The crank-pin is 9 inches diameter, and 10 inches long between the crank webs, and 9¾ inches diameter in the webs. The shaft journals are 9 inches diameter, with a total length of 68 inches for each engine. The diameter of shaft in the eye of the crank web is 9¾ inches.

The condenser chests are cylindrical in form, built up of sheet brass ¼ inch thick, and sustained by angle and T rings and composition flanges for the tube plates. The exhaust and discharge nozzles, also the chambers for the circulating water, and covers for the same, are of composition. The diameter of the exhaust opening is 18 inches, and of the discharge opening to air pump 12 inches. The injection and delivery openings for the circulating water are 11 inches in diameter. All flanges are not less than 2½ inches wide.

A ¾-inch salt water feed valve is attached to each condenser. Each chest contains 2,151 seamless drawn brass tubes ⅝ inch outside diameter, No. 20 B. W. G. thickness, spaced $\frac{1}{16}$ of an inch between centers.

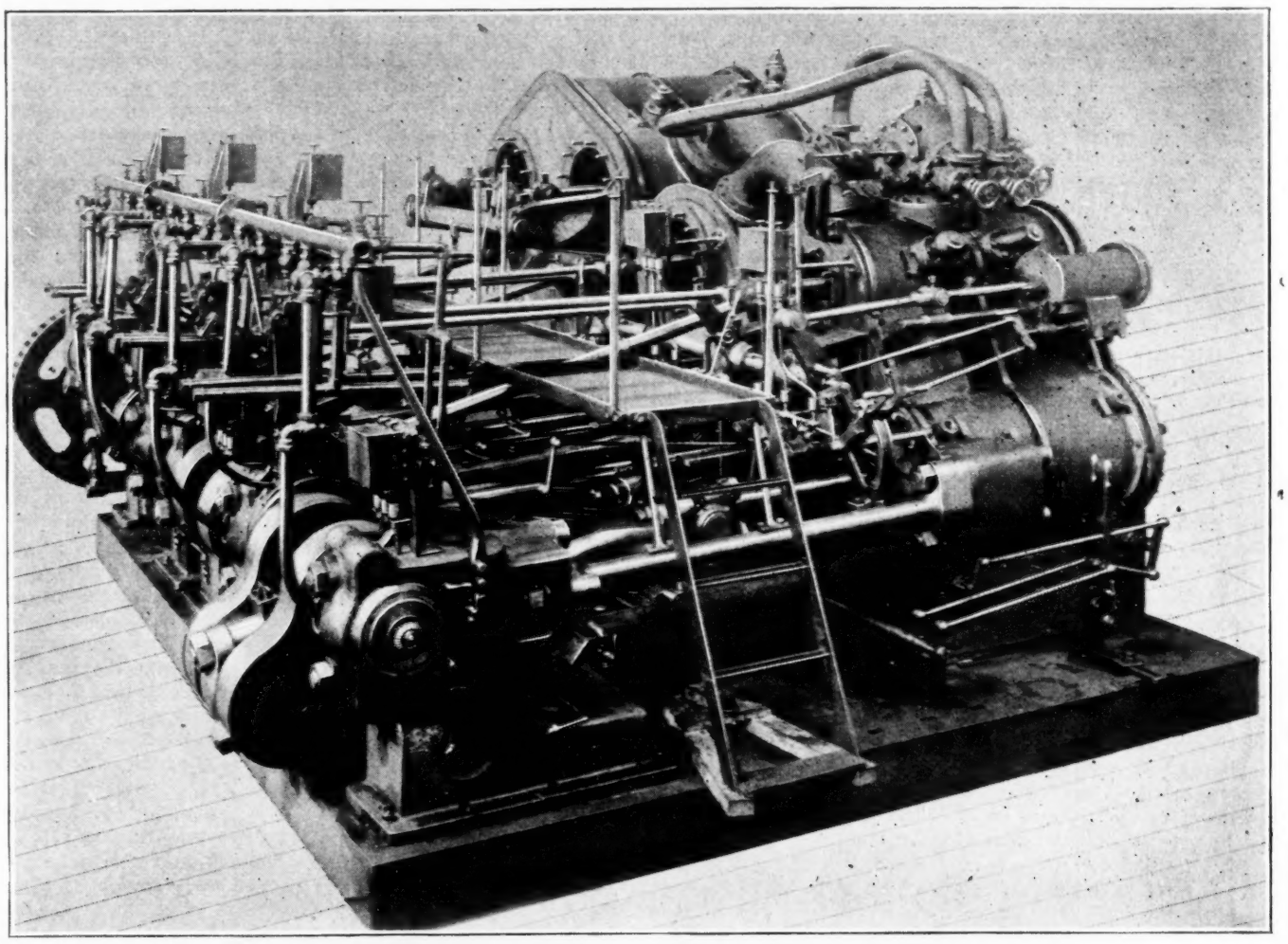
The exposed condensing length of tubes is 7 feet, and the total cooling surface is 2,450 square feet. The tubes were thoroughly tinned inside and out previous to the last drawing.

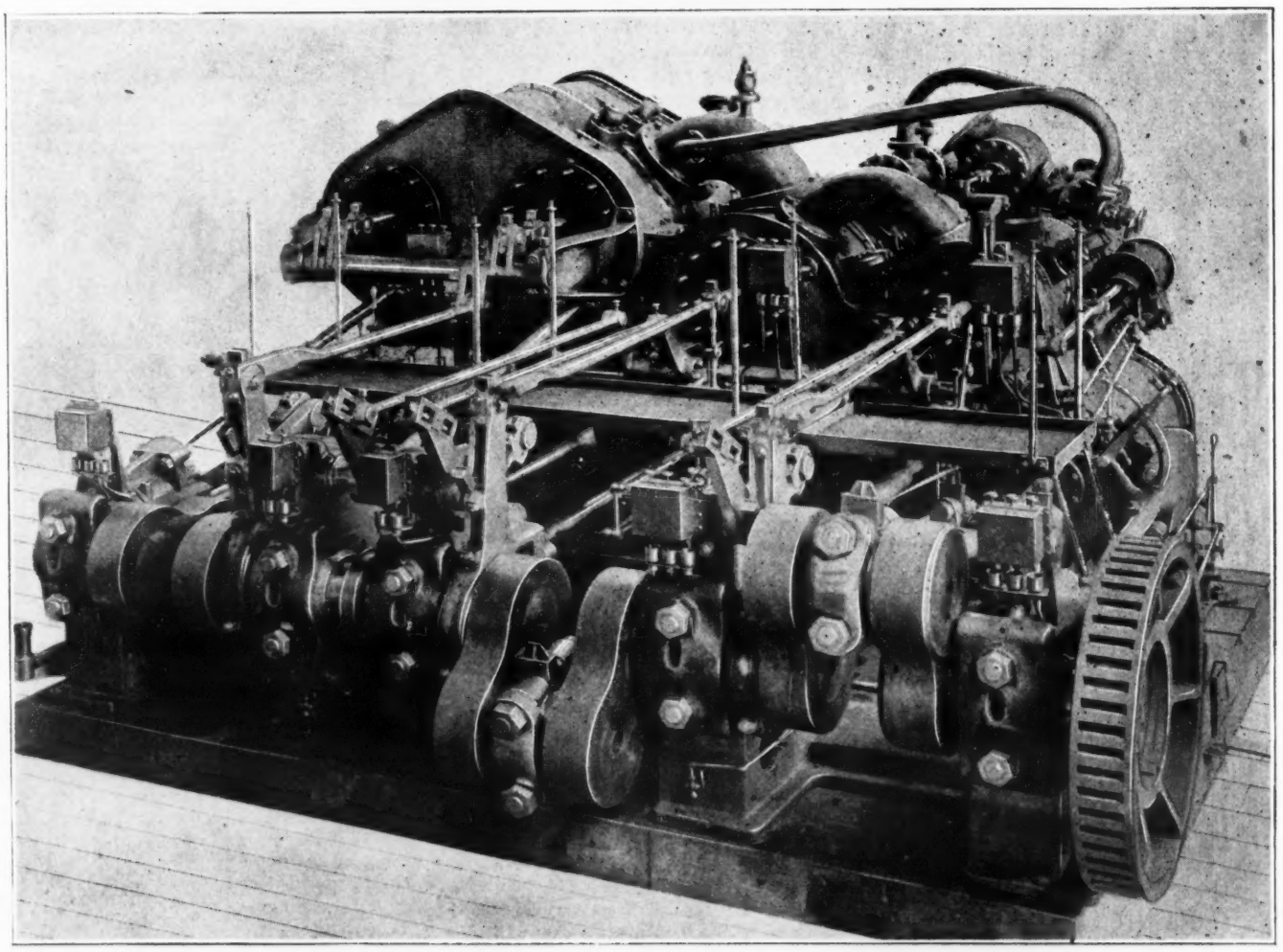
The tube plates are of brass ¾ inch thick, and stayed to heads by three ⅞-inch stays. The plates are counterbored ⅞ inch diameter, and $\frac{9}{16}$ inch deep, the packing is compresed

by composition glands screwed into the plates, and have a device for preventing crawling of the tubes. The condenser is located behind the engine cylinders and secured to the ship.

Each engine has two vertical single-acting air pumps 18 inches diameter and 12 inches stroke, a double-acting circulating pump 18 inches diameter and 12 inches stroke, and one double-acting bilge pump 4 inches diameter and 12 inches stroke, operated by an independent engine with cylinder 14 inches diameter and 12 inches stroke. The pump cylinders, valve chests, covers, bonnets, buckets and rods, plungers, valve seats and guards are made of composition; the valves, of hard rubber.

The centrifugal bilge pump in forward engine compartment is capable of discharging with ease 800 gallons of water per minute against a head of 15 feet when using steam of 50 pounds pressure above the atmosphere. The pump is operated by a special engine connected directly with it; it takes steam from both main and auxiliary steam pipes direct, and exhausts into the condenser through the auxiliary exhaust main. Pump casing, fan and pump shaft are made of composition. The line shafting is made of steel, with nine raised collars for taking the thrust, $1\frac{1}{4}$ inches thick, $12\frac{1}{2}$ inches outside diameter, with spaces $1\frac{5}{8}$ inch wide. The shaft is finished 9 inches diameter, with coupling disks 18 inches diameter, and $2\frac{1}{2}$ inches thick at forward end, and the after ends enlarged and made with socket bored 14 inches deep, and tapering from $9\frac{1}{4}$ to $8\frac{1}{2}$ inches. The line shaft for the forward engine is about 27 feet 6 inches long, and has a hole 4 inches diameter axially through it.





ENGINES FOR THE NEW GUNBOAT CONCORD.—SEE PAGE 4.

The propeller shaft of each engine is made of steel in two lengths. The forward length is about 22 feet 7 inches long, the diameter varying from $9\frac{1}{4}$ to $9\frac{3}{4}$ inches, and has a 4-inch hole axially through its length. The after length is about 28 feet long, $11\frac{1}{2}$ inches diameter in middle of length, and with a 7-inch hole through it. The diameter of shaft is reduced to $9\frac{3}{4}$ inches at after end. The hole through the shaft is reduced from 4 inches to 2 inches at after end.

The propellers are made of manganese bronze, $10\frac{1}{2}$ feet diameter, pitch 13 feet 3 inches. The blades are adjustable.

The stern pipes and outside bearings have composition bushings, divided into halves and fitted with lignumvitæ staves. The bearings in stuffing-box are about 17 inches long, the outer ones 32 inches, and those in hangers 40 inches. All lignumvitæ bears on end of grain.

The boilers are placed forward of engines. They are placed in pairs longitudinally, one pair forward and one pair abaft an athwartship bulkhead passing under center of smoke pipe. The boilers carry a working pressure of 160 pounds by gauge. Each boiler is 9 feet 9 inches mean diameter outside, and 17 feet 5 inches long from head to head. Each has three furnaces 37 inches least internal diameter, and extend to combustion chamber.

Each furnace has a grate 69 inches long, and 18.4 square feet in area, aggregating 220.8 square feet in four boilers. Each boiler contains 438 lap-welded wrought-iron tubes, of which 68 are stay tubes. Every third tube vertically and horizontally is a stay tube; they are No. 6 B. W. G. thick, and $2\frac{1}{4}$ inches external diameter. The other tubes are No. 11 B. W. G. thick, and $2\frac{1}{4}$ external diameter. The stay tubes are screwed into both ends; the back ends are swelled and fitted with a nut on outside of head. The plates in the shells are $\frac{13}{16}$ inch thick; tube sheets $\frac{9}{16}$ inch thick. The furnaces are made of steel $\frac{1}{2}$ inch thick, welded at joints and corrugated.

The length of the "Concord" is 230 feet on water line; extreme breadth, 37 feet; mean draught, 14 feet; displacement, 1,700 tons. On her recent trial trip she attained an estimated speed of 17.8 knots. The engines and boilers were built by the Quintard Iron Works, New York City.

A Montreal dispatch says: The Dominion Cotton-mills Company, composed of wealthy Montrealers, A. F. Gault being president and Mayor Grenier, vice-president, has completed the amalgamation of the nine gray-cotton-mills of Canada. These mills, which were built at a cost of $4,800,000, have been purchased out and out by the company for $3,800,000, and will come under the new management January 1. Two or three of the smaller mills will manufacture exclusively for export to China, West Indies and South America. The capital of the company is $5,000,000.

A calamity has fallen upon Cromford. The historic old cotton-mill, where Arkwright first set up his cotton-spinning machinery, caught fire, and, though six fire engines played upon it, nothing could be saved. A large portion of the mill has long been standing empty, as the motive power (water) was inadequate, but for the last seven years Mr. Charles Hill, of Bridge House, Cromford, has used one portion of it for finishing and storing the goods made at his factories at Via Gellia and Milford. The loss will be fully £10,000. The roofs and walls have given way, but the houses near have been saved.—*Pall Mall Gazette.*

The Beam Engine.

BY W. H. BOOTH.

F. S., of New York, asks where he can get a drawing of a beam engine. Perhaps the editor of the AMERICAN MACHINIST would not mind sending him the lithograph which I herewith enclose.

The lithograph in question is of a pair of very large beam engines at the mill of the Craven Bros., at Keighley, in Yorkshire. The engines when put in, if not still, were the largest mill engines in existence, but I am unable now to give any dimensions. For years, indeed until about twenty-five years ago, beam engines were universal for textile factory driving in this country. The English type of beam engine differs materially in appearance from the type prevailing in America—the beam is longer, and the construction generally more massive.

Almost invariably the beam was a heavy casting, and, for a long time after horizontal engines were introduced, it was always held that, for cotton spinning especially, beam engines gave better and more regular turning. This was undoubtedly a fact, but was simply due to the fact that in the beam engine ponderous masses of cast-iron—the beam and connecting rod required to be put in motion, and brought to rest every stroke, and by their inertia action absorbed and gave out again the energy of the steam on the piston without sudden change being made in the rotative velocity of the crank. When the horizontal engine was introduced—and for years after—it was simply fitted with the same old fly-wheel as its predecessor, and, as at first horizontal engines did not run at present day speeds, the consequence was that the steadying action of the heavy beam was missed, and hence there arose the opinion that the beam engine was more regular in rotation, but no one seems to have guessed why. After a time, however, horizontal engines were set to run faster, and this in itself tended to steadiness, because it increased the stored energy in the far too light fly-wheel; but all this time, too, pressures were increasing, and compounding was coming into vogue, and the power obtained from a certain size of engine became much greater. Thus, for example, the nominal 60 H. P. beam engine had a 42-inch cylinder and a seven-foot stroke, and ran originally at nineteen revolutions, and (in 1830 or thereabouts) was worked by boilers at seven pounds gauge pressure. In my younger days this same engine of 60 H. P. nominal was supposed to and did actually indicate 280 to 300 horse-power. Now the compound horizontal engine with 40″ L. P. cylinder, and only six foot stroke of ten years ago, would indicate from 400 to 500 horse power, and thus, though the rotative speed would be higher, the fly-wheel would be required to keep at a steady speed from 30 to 50 per cent. more machinery than it was called to do when assisted by the heavy beam. Later on, owing to the exceedingly bad work of some of the tooth wheel makers, geared engines became discredited, and there was a rush upon engines with belt pulleys of large breadth, and, as it was soon found that belts were more efficient at high velocities, the fly-wheel rims were made larger, and engine speeds were increased also. This made the newer engines more steady than the earlier geared horizontals. Belt-geared engines did not come into very extended use in Lancashire, but were very largely used, and are yet in Yorkshire, though some very large belted engines exist in the former or cotton country. In Lancashire, however, as a rule, belts were quickly run off the ground by ropes. These were found to give still more steady turning, but the reason is obvious. Speeds had been growing higher, and the rim of a large rope pulley is very heavy, so that a pair of 40-inch engines, which in old beam-engine days had a 23 foot diameter fly-wheel of 20 tons, aided by the beams, have now a huge rope rim of 26 to 30 feet diameter, and weighing 70 to 80 tons. Needless to say this is the cause of the beautifully steady turning. Piston speeds are now 700 to 850 feet per minute, and one hardly ever hears of a beam engine being now made except for mine drainage and water pumping generally.

The chief cause for the disuse of the beam engine was probably its frequent breakdowns, and the exceedingly perfect nature of these breakdowns, which generally meant an entirely new engine. These disasters were very frequent as boiler pressures increased, and heavy stresses were put on old and light engines beyond what they were intended. The presence of a small quantity of water in the cylinder would bring an engine to the floor. This cause was especially fruitful of disaster when valves were used of a type that could not leave their seats. The old valve with hemp-packed back was able to spring a little off its seat, and allow water to escape, but Corliss and piston valves would not do so. There are still running in this country large numbers of old beam engines, built by old firms like the Lowmoor Iron Co., and there are still quite a number of the inverted beam engines or side lever engines made by Boulton & Watt, and devised originally to drive steamship paddle-wheels, but used in large numbers on land also.

The beam engine was converted into a compound engine by the addition of a cylinder between the beam center and the connecting rod. In this way old and weak engines were given a new lease of life, and made to work up to 60 or 70 pounds pressure.

This system of compounding was also applied to new engines, and the lithograph I enclose shows that these large engines were built as compounds from the first. Throughout the whole history of mill engines it would appear that the question of inertia has never been understood, and that credit for steady turning has been given to the wrong detail all along. Engines have gone out of fashion nominally for one reason, whereas actually it has been the fault of some special detail only. Thus it is that faulty gears and lack of water relief valves, combined with a rise of boiler pressure, condemned the beam type of engine; the use of too light a fly-wheel condemned even good gears on the horizontal engine; and nowadays ropes get the credit for the regular turning of to-day, which is really a product of speed and weight. As a fact, ropes are an expensive adjunct, and cost in fuel something like ten per cent. of the whole coal consumed, but they are made of cotton in the cotton districts, and seem to be helping trade thereby. They are also most convenient for taking off power to different shafts at different flats of a building, and will not be readily displaced.

LETTERS FROM PRACTICAL MEN.

Friction Brakes.

Editor American Machinist:

I am quite interested in Mr. Flather's articles on the Measurement of Power, and can inform him that the "babbitt metal" friction brake, which he suggests, was used by the late Uriah A. Boyden, in 1851, in the test of his turbine wheels at the Atlantic Mills, in Lawrence, Mass. The friction pulley was grooved, and the babbitt shoes cast to fit it, as I was informed.

I was in England at the time, at the first "Crystal Palace," in Hyde Park, and did not see the test. I afterward tried to get the apparatus, to make a test of a large turbine at the John P. King Mill, in Augusta, Ga., in 1884, but it had been destroyed. I then had a brake made like the one shown in his Fig. 2, using a friction pulley 7 feet diameter, and 24″ face. The brake lever was an oak stick, 16″ square, reaching 15.91 feet from the center of shaft to the point of connection with a bent lever scale beam, which had a leverage of 2 to 1, to reduce the amount of weights to be handled. As the shaft was vertical, the surface of my brake was horizontal, and I lubricated with strong soapsuds, fed from three two-gallon cans, set at intervals around the brake. Beside this, I kept a thin jet of cold water from a hydrant, using a hose pipe with a flattened nozzle, playing in the jaws of the brake. The apparatus worked perfectly, and I obtained a steady test of 475 H. P. at 76.19 revolutions per minute of the wheel. The strap of the brake was made of boiler-iron, and lined with blocks of soft wood, and the pulley had deep flanges, so that the brake set into it like a saddle. The iron clamp or shoe was in two pieces, hinged together at a point opposite the regulating bolt.

I never heard of Mr. Druitt Halpin, or his arrangement, but this apparatus was made for me by Mr. Geyelin, the engineer of Messrs. R. D. Wood & Co., of Philadelphia, who had furnished the wheel which was to be tested.

I do not now remember the exact amount of power obtained by Mr. Boyden at Lawrence, but think it was not quite so great as the amount handled at Augusta, this latter test being, I believe, the heaviest one ever made with a Prony brake.

The velocity of the surface of the friction pulley was 1,676 feet per minute, which, with the 24″ face worked out by Mr. Flather's method, would give a coefficient of 847, agreeing very closely with the figures he gives.

Self-cooling brakes, where both the rim of the pulley and the brake-strap were hollow, with a stream of cold water flowing through them, were used by James Emerson, at Lowell, in 1869, using oil on metallic contact surfaces. For light and delicate tests, I have found a cork lining very good if well lubricated.

SAMUEL WEBBER.

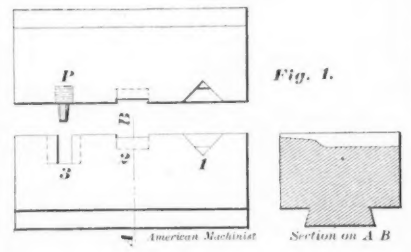


Fig. 1.

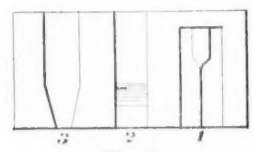


Fig. 2.

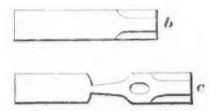


Fig. 3.

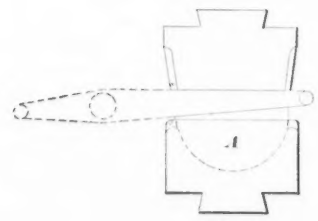


Fig. 5.

Fig. 4.

Forging with Dies in the Lehigh Valley R. R. Shops.

Editor American Machinist:

While in the repair shops of the Lehigh Valley R. R. Co. at South Easton recently, some interesting methods and tools were observed, which, as time savers, deserve to be noticed.

In the blacksmith shop a 200-pound Bradley hammer was kept in constant use, dies of different forms being employed on a variety of work. These dies were not of the expensive drop die order—steel, profiled to shape and hardened—but were plain cast-iron blocks with the desired shape cast in their faces.

One pair of dies was doing some very creditable work forging straight pene hammers, of which several hundred per year are used around the shops and on the engines of this road. The stock for these was inch and a quarter square steel cut long enough for two hammers, which were roughed out, and the eye formed at the rate of ten to twelve per hour. Figs. 1 to 3 show the dies and successive operations under the hammer. The punch *P* for eye is of hardened steel and is screwed into the upper die as shown in Fig. 1. The corners of the stock are first broken down in recess 1, leaving the piece as shown at *b*, Fig. 3, then the pene is formed in recess 2, the pieces being turned over during the operation, after which the eye is formed by holding in 3 and punching one-half way through from each side; in this way *c*, Fig. 3, is produced.

A second heat is now taken, and the other end worked up in like manner. After separating, it is necessary to drift out the eyes and dress up the ends; very little work, however, is required as a man can finish up four or five of these forgings in an hour. It occurred to the writer that blacksmiths' chisels could be cheaply formed in the same dies; working the steel to draw down the cutting edge after forging under the hammer would probably restore the fiber if affected by the squeezing action of the dies.

A die for working tapers of any angle on flat iron or steel has recently been put into use, and gives very good results as far as tried. The device is very simple. It consists of a lower and upper die with a loose semi-circular piece *A*, Figs. 4 and 5, which is free to slide in the recess cast in the lower die block. This sliding block is of hardened steel and forms the working face of the lower die. The upper die is a plain flat surface. As long as the two faces are parallel the work will be parallel, but if one end of the work be lowered the loose block will slide on its seat, thus producing an angle with the upper hammer face, as shown in Fig. 5, where a piece of work is being drawn to a taper. As this angle is under the control of the workman, it will be seen that varying angles, and thus varying tapers, can be produced at will without separate dies. The loose block cannot be forced out of its seat, as the metal in front of the block in the lower die acts as a stop when the work is held too low. The object of placing the sliding block to one side of the center of the die face is to leave a flat surface for drawing out the parallel sides of the work.

The writer was shown a pair of brake levers which had been forged with these dies, the two ends being drawn out to a different taper, as shown in Fig. 5, and the results were most satisfactory—the surface being as smooth and free from hammer marks as rolled stock.

J. J. FLATHER.

A Cupola Explosion.

Editor American Machinist:

I read with interest the opinions of readers of the AMERICAN MACHINIST as to the cupola explosion in New York. Perhaps they may be interested in an explosion at Pueblo, Colo., Nov. 24. The blast had been on but a few minutes when an explosion occurred. The cupola was wrought-iron, brick lined.

The cause of the explosion was a 20″ air piston of an Ingersoll compressor. This piston was of the one-piece type, but cast hollow with several plugs screwed in. I examined it after the explosion, and it had the appearance of having contained water and steam.

R. D. W.

Bending Stress in a Rock Shaft.

Editor American Machinist:

Your answer No. 457, issue December 4, neglects the bending stress on the rock shaft, the data for which is not given by the querist. This force is rarely absent in connection with twisting stresses, and sometimes is the most important force of the two. In the case of the rock shaft, assuming the distance from center of pin to effective end of bearing to be 3 inches, the bending moment is 3,000 inch-pounds. It is usual to combine these forces, thus $T = \sqrt{t^2 + M^2}$, t and M being respectively the separated moments of torsion and bending, and T a new twisting moment representing the combined forces. Then by your equation for the steel rock shaft,

$$d = \sqrt[3]{\frac{14{,}320}{1{,}960}} = 1.95 \text{ inches.}$$

The leverage exercised in bending is uncertain, as the effective point of support for the shaft must be somewhere inside of end of

bearing. If the shaft fits badly, this leverage may become very great. I usually consider it to be at least half the diameter of the shaft, plus the distance from end of bearing to point where the force acts.

It will be remembered that the tendency to destroy the shaft is much greater, in the case of rapid vibration, as in this instance, than when the force is continuous in direction. It is common practice to consider the stress as doubled in destructive tendency. If we desire to break a wire we naturally bend or twist it rapidly back and forth. In this event your equation would become

$$d = \sqrt[3]{\frac{14.320}{980}} = 2.45'' \text{ diameter.}$$

J. C.

Piston Rod Straightener.

Editor American Machinist:

I enclose herewith a sketch of a piston rod straightener. As this operation is a very frequent job around R. R. shops, time and labor can be saved by something of this nature, while nothing better seems to have suggested itself through the papers. This is offered to those who are unfortunately carrying hot pistons around the shop—taking the temper out of both good machinists and lathe centers. L. C. SHARP.

Center Indicators.

Editor American Machinist:

In these days of fine measurements most machinists find a center indicator necessary sometimes, so every one would like to have one in his "kit." I undertake to show one in Fig. 1. I think there is no other kind yet devised that is as reliable, and takes up so little room when not in use. For mine I used ⅛" Stubbs steel wire for the indicating end, and also for the piece with the centers. I used ¼" square steel for the connecting link, the wire only being driven through the holes in this piece.

For the benefit of those who might not have seen this form of indicator, I will say that the center *A* is made to enter the center punch mark laid out on the work, which is clamped to the face plate of a lathe, in such a way as to allow it to be easily knocked for tracing. The other center *B* is made to enter the center punch mark *B'* in spring tool (Fig. 2). The spring tool, of course, is clamped in the tool-post, and the part of indicating wire marked *C* rests upon top of spring marked *C'*, on which it slides and rocks, till the work is trued.

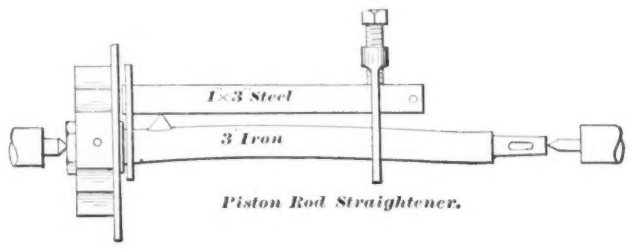
In making the spring tool, I riveted the spring to a piece of the regular lathe tool steel, as is shown, and by the big washer I have about the same friction as in friction calipers, so that this spring can be knocked to easily get the right height.

I like to have the point of indicating wire to about correspond with the tail center of the lathe when work is trued, for convenience.

This indicator, when made in the ring form, is old, but I believe this one is quite an improvement on the old. In the first place, where the ring is used, the part *C*, when resting upon the tool, is always sliding up and down an incline, due to the curve of the ring, and this turns the indicator on the centers, so if the extreme point of the indicating wire is not just in line with the centers it will not indicate correctly. With the one I show, the wire, being about straight where it rests on the tool, has no tendency to turn on the centers, so it does not make any difference about having all the points exactly in line. In the next place it is cheap, which will commend any good thing anywhere. I don't believe that any one who uses an indicator like this once, will ever go to the trouble and expense of making one of those gimbal joint affairs, with all its chances of "back lash."

We would need a very large lathe if we tried to swing every job. I think a center indicator for drill presses is something new, so I undertake to show one in Fig. 3. Every one knows, who has ever had any experience in the matter, that it is a very uncertain piece of business drilling to a line by chipping over the center with a set-over chisel, when any degree of fineness is required. Of course, in proposing this tool, I suppose it to be used on a drill press which is in condition to do such a job.

I think the idea is shown quite plainly in the illustration. If the drill center runs true, of course it would be all right to revolve the indicator around the spindle, but as most drill centers do not run true, it would be best to make the spindle drive the indicator by using the backing-out key, as is shown. When the point of thumb-screw *A* will not increase or reduce the space between itself and the spindle when making a revolution, the laid-out hole is very nearly under the center of spindle. Then if the surface of work is solid stock and level, a very short flat drill, with the point well thinned, will bore out a recess that will start another drill very nearly right.



Piston Rod Straightener.

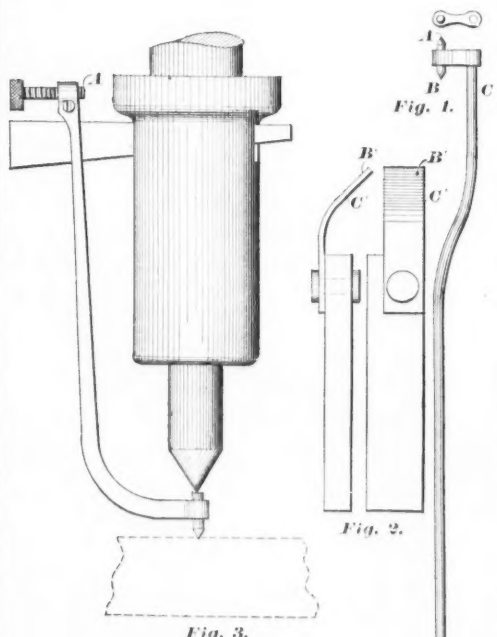
If greater fineness than this is desired, a hole can be drilled smaller than the finish size, and a single-pointed cutter (I believe there is a tool for this purpose on the market) be used to bore, so as to start a rose bit correctly. A MECHANIC.

Hardening Dies.

Editor American Machinist:

Some time since some one asked for a method of hardening dies for a drop-hammer. I have been successful in that line; have not had a die spring in twelve years.

Heat your die in a coke fire, to a bright red heat, and take from the furnace as quickly as possible, and place directly over the water tap turned on full force, and in such a way that the water will strike the center of the impression and cool the die as quickly as possible.



CENTER INDICATORS.

I hardened, some seven months ago, a pair of dies 7"x7"x22¼". They were in as good shape as when they left the planer, and were intensely hard. They have been in use every day since, doing hard work.

One of the secrets is to have a good coke fire so as to heat the steel uniformly all over, without this, failure is pretty sure.

JAMES FROST.

It is said that the life of a locomotive would be much longer than it is, but for the fact that it is addicted to smoking.

Manufacture of Tin Plate.

The "Journal of the Franklin Institute" for December publishes a paper by F. Lynwood Garrison on the manufacture of tin plate.

The author starts out by stating, in effect, that tin plate manufacture appears to be in the nature of a mystery in this country, which may be true, but the immediate conclusion that he arrives at, that the people imagine that what is called tin is composed entirely of that metal, is, we believe, not true. But notwithstanding the poor opinion he has of the intelligence of the people, the author gives information on the general subject of tin plate manufacture that will interest a good many.

After tracing the origin of the industry he concludes that ninety per cent. of the tin plate used is made in Great Britain. He then goes on to show the inception of tin plate manufacture in this country, at Wellsville, Ohio, and at Leechburgh, Pa., both enterprises being obliged to cease work owing to fall of prices, as was also the more extensive works at Demmler, near Pittsburgh. These attempts to make tin plate were between the years 1873 and 1878.

Referring to the manufacture, he says: "The finished bars used in the manufacture of tin plates vary in dimensions according to the size and weight of the sheets required, or the manner of rolling.

"After the finished bar has been sheared to the required size it is heated to redness in a reverberatory furnace and rolled, again heated and rolled, and doubled; heated a third time, rolled and again doubled, then heated and rolled a fourth time. Sometimes the heating and rolling is continued six times.* * *

"When the plates leave the rolls they are called, 'finished' and are known as black plates. * * *

"The plates are now pickled by being immersed in hot dilute sulphuric acid (one part acid to sixteen water), contained in lead-lined tanks. The sheets are placed on edge in a wooden rack made for the purpose, and the whole immersed in the acid. By means of a suitable mechanical arrangement, the rack holding the sheets is given a regular up-and-down motion, thus maintaining a circulation in the acid bath.

"When all the scale or oxide has been dissolved, the rack holding the sheets is immersed, and the whole washed several times in fresh water. * * *

"The sheets are then dried, packed in tight annealing boxes or pots, and annealed in from twelve to twenty-four hours in a reverberatory furnace. * * *

"In order to receive a proper coating of tin and to possess a fine finish it is necessary to pass the sheets singly through a series of highly polished cold rolls. * * *

"After the cold rolling the sheets become more or less harsh, and to remove this they are again annealed in the same way, but at a somewhat lower temperature than the first annealing. Ten hours is usually found sufficient for this purpose.

"The surface of the sheets having become somewhat oxidized by the cold rolling and second annealing, it is necessary to pickle them a second time In this operation, which is known as 'white pickling,' a much weaker solution of sulphuric acid is used, or sometimes hydrochloric acid is used instead. The slight coating of oxide scale is thus quickly removed, and after being washed with water the sheets are supposed to be ready for the coating of tin. * * *

"As the sheets are removed from the water trough they are immediately plunged, sheet by sheet, into what is known as the grease pot, which is filled with hot palm oil or tallow.

"The object of the oil bath is to remove the moisture and to warm the sheet so as to prepare it for tinning.

"After remaining in the hot grease some time, they are removed in parcels and plunged into the tin pot containing a bath of molten tin covered with palm oil. Here they are allowed to soak for about twenty minutes, the tinman constantly opening and re-opening the pack with his tongs, thus enabling the molten tin to get at every part of the surface. As a result of the soaking, the iron (or steel) absorbs a certain amount of tin on or into the surface of the sheets. * * *

"When the sheets have soaked sufficiently, the tinman removes them from the tin pot and hands them to the washman, who plunges them in parcels into the wash pot filled with tin, and allows them to remain there, to keep hot, until he is ready to use them. They are then removed in batches and placed upon a flat iron plate, called the hob. With a thick hempen brush in one hand and tongs in the other, the washman brushes the two sides of each sheet in order to remove the excess of tin which has collected between them. The wash pot is generally divided into two compartments, one larger than the other. The sheets are first put into the larger compartment, which contains a better quality of tin than the tin pot, and, as its temperature is comparatively low, the sheets can be kept in it a considerable length of time without becoming 'dry.'

"To obliterate the marks left by the brush, and to give a polish to the surface, the sheets are dipped, one at a time, into the smaller compartment of the wash pot.

"Then, without releasing the sheet from the tongs, it is passed between a pair of steel rolls into the 'patent pot.' As soon as the sheet has passed through these rolls into the tin below, it is caught, moved along and raised by means of a cradle to meet another pair of rolls revolving in the surface of the tin bath; thus, as one sheet is rolled into the bath of tin another is rolled out. The object of these rolls is to squeeze off the surplus tin and give the sheet a smooth, even surface.

"The sheets are now placed in a rack to cool, after which they are taken by women and rubbed with sawdust or bran to remove the grease, then polished with flannel or buckskin, and removed to the sorting-room. Here they are very carefully examined and classed according to finish and quality."

The Manufacture of Rubies.

What is the use of exploring unknown and dangerous countries for rubies, when the secret of their artificial production has been discovered? This was the question which the Academy of Sciences discussed on the report of MM. Fremy and Verneuil, who for some time past have been making chemical experiments in the manufacture of these stones. More valuable than mere theory was the fact that the two chemists exhibited some hundreds of specimens of the glittering red crystals they had succeeded in producing. The rubies were admitted by all to be much superior to anything hitherto manufactured. No little danger, however, attends the process. The chemicals have to be fused at a heat so intense that M. Verneuil during the course of the experiments nearly lost his sight. While manufacturing rubies the two chemists found that at a certain stage of the operations crystals of the color of sapphires were produced, but the hue hitherto obtained has not been equal to the tint of the real gem.—*Pall Mall Gazette.*

It is said that the steamship El Sol, of the Morgan line, which recently left on her maiden trip for New Orleans, is the largest freighter in the United States. She is 404½ feet in length, 48 feet beam, and 34½ feet depth; her registered tonnage is 4,300 tons. She was built by the Cramps.

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CONTENTS.

	PAGE.
Hydraulic Ship Builders' Tools	1
Odontics, or the Theory and Practice of the Teeth of Gears. By Geo. B. Grant	2
Improved Lever Forge	3
Countersinking and Drilling Machine	3
The Manchester Canal	3
Sketches of an Apprenticeship. By W. S. Rogers	3
Micrometer Depth Gauge	4
Getting the Earth	4
Engines for the New Gunboat "Concord."	4, 5
The Beam Engine By W. H. Booth	6
Letters from Practical Men: Friction Brakes By Samuel Webber—Forging with Dies in the Lehigh Valley R. R. Shops. By J. J. Flather—A Cupola Explosion. By R. D. W—Bending Stress in a Rock Shaft. By J. C—Piston Rod Straightener. By L. C. Sharp—Center Indicators. By A Mechanic—Hardening Dies. By James Frost	6, 7
Manufacture of Tin Plate	7
The Manufacture of Rubies	7
A British Army Officer's Opinion	8
The Commission of Labor on Machinery	8
Development of the South	8
Questions and Answers	8, 9
Manufactures	9, 10
It is an Evil	10
Tool-rooms Kinks. By Fred. H. Colvin	11
Building the Shop Floor	11
Machinists' Supplies and Iron	12

A British Army Officer's Opinion.

Naturally the words of high praise spoken by Lieut. Col. W. Hope, V. C., of the British Army, for the excellence of the work being done in this country on our built-up guns, have attracted considerable attention here, and we shall expect to see the matter very fully discussed, and Col. Hope very vigorously condemned by our British contemporaries. And we have to confess that we are at some loss as to what to make of some of Col. Hope's declarations. For instance, he is reported as saying that "It would be courting national disaster on the part of his government to put the present British navy gun against the new ordnance as mounted on American vessels." This is rather an extraordinary statement for a British army officer to make; but Col. Hope emphasized it by much more talk in the same vein, and he is said to be a man who has a habit of understanding what he is saying, when it comes to matters of ordnance. He says that English gun making is handicapped by such firms as William Armstrong & Son, who have been much more successful in making money than in making good guns. That which is perhaps most difficult to understand is what he says regarding the fixing of responsibility for errors and mistakes in measurement. On this point the published report of his words is as follows: "What has impressed me, perhaps more than anything else in my study and observation here, is the manner in which affairs are carried on in the ordnance department of the United States Navy. There is an absolute certainty of being able to detect the person responsible for any error or blunder. This is accomplished without any red tape, and to my mind accounts for the accuracy of construction of the built-up gun."

This would seem to indicate that built-up guns are made in England in such a way that not only are the different parts liable not to fit properly, but when this does occur the responsibility for it cannot be fixed, which, to an American familiar with shop practice here, is almost inconceivable.

The comparison drawn by Col. Hope between the American and English practice in gun making is either very flattering to us or very discreditable to them, whichever way one chooses to take it; but an American who should say even much less than he has said, would, we fear, be put down by our English contemporaries as an insufferable brag, and —— "a Yankee." We wait to see what they will do with this man, who is their countryman, and a distinguished officer in the British army.

The Commissioner of Labor on Machinery.

Carroll D. Wright, Chief of the Department of Labor at Washington, recently delivered a lecture in Brooklyn, in which, according to the published report of his words, he gave evidence that some of the study which he has given to industrial problems has been misdirected. After misrepresenting what has been called the "New Political Economy," by saying that it teaches that the progress of the world necessitates poverty, he went on in an effort to prove that poverty is constantly decreasing, and in the effort seems to have succeeded very well in proving just the opposite. This he did by such statements as that, while formerly there were no poorhouses throughout the South, now the South, like the North, is dotted with poorhouses. "Yet," said he, "no one will say that the negro should go back to slavery," as if that proved that poorhouses were a blessing, and an evidence of the absence of poverty.

He declared further that the accumulation of wealth simply made the poor man's poverty "more observable by contrast," and in this observation lies the whole gist of the matter, if Mr. Wright would only take the trouble to think it out. Poverty is not measured so much by what one actually has as by how much he falls short of the general standard of living in the community in which he resides. In these days, when machinery has put so many things—formerly considered luxuries—within easy reach of the ordinarily well to do, the men who work in New England factories or Pennsylvania mines for an average wage of one dollar per day are the poorest paid workmen in the world's history, disguise the fact as we may by pointing out that their floors are perhaps covered with a cheap carpet, while the workman of old had none. The standard of living is different, and we must take human nature as it is, with all its ambitions and natural desire to avoid being conspicuous by poverty. If the majority of South African belles wear nothing but a single ring of brass about one ankle, the belle who can wear two is wealthy, while if the prevailing style is to wear two, the one who can wear only one is poor.

According to Mr. Wright, "the division of labor has made trades almost unnecessary"; and yet in another place he says that, "While it was once enough for a man to be good, now he must be valuable." But in order to be valuable it seems to us he must have something equivalent to a trade. A man's value depends upon what he knows or can do above the commonest labor. Finally he repeats the old worn-out and silly slander that drunkenness is at the bottom of all the poverty.

The address, which was on the subject of machinery, and its effects upon the progress of the world, pays a high tribute to machinery, with which, of course, we agree, but we confess to some interest in the men who make and operate this machinery.

In Mr. Wright's words directly upon the subject of machinery we find evidence of the same confusion of thought. For instance, he says: "There was a time in Europe when a single sheet represented the work of thirty-two days. Now machinery has made it possible to turn 13 cents' worth of cotton into chintz worth $4, and to change 75 cents' worth of crude iron into $2,000 worth of needles." He seems to regard this as a triumph for machinery, notwithstanding the fact that the constant effort in designing machinery is to reduce the cost of its product. Hand labor could turn 75 cents' worth of crude iron into needles having a value of many times $2,000, if that were desirable; and the ideal machine will turn 75 cents' worth of crude iron into say $1 worth of finished needles, or 13 cents' worth of cotton into chintz worth say 15 cents.

Mr. Wright may be a very good Commissioner of Labor, but we think he would be a better one if he would brush up his political economy a little, and try to get over the foolish notion that all poverty results entirely from drunkenness.

Development of the South.

It is, of course, true that the South is developing in an industrial way very rapidly, probably more rapidly just at present than any other section of the country; but we believe that some allowance must be made for the published accounts of new enterprises coming from that quarter. The *Manufacturers' Record*, of Baltimore, which confines its operations almost entirely to the South, gives far more attention to the collection of information regarding the formation of new manufacturing enterprises than any other paper we know of, being, in fact, devoted mainly to this work. It has correspondents at all points through the South, who send in accounts of new enterprises, and it is evident that these correspondents do not assure themselves in every instance that a proposed factory or other enterprise is to be a bona fide thing, but simply send in an account of everything talked of, and a new account at every stage of its progress, provided there is any progress. Then, too, there is considerable evidence that men who are interested in real estate take pains to have it announced that a company with a very large capital stock has been formed, and will build immense factories in the town where this real estate is located, often stating that this concern is to move from some northern or eastern town. Every such report that people can be made to believe, helps in obtaining high prices for lots, and hence the incentive for the invention and circulation of the reports.

It is well nigh impossible for any news paper to sift and ascertain the full particulars regarding each and every one of these matters, and the only thing that can be done is for those interested to go through the sifting process before becoming involved in any way. Attention has been called to the fact that a single issue of the paper named recently contained notices of the formation of companies for various industrial purposes in the South, representing a capital of $10,000,000. It is a weekly paper, and it is easy to see that, if all these were bona fide, there would soon be no room left there for agricultural operations.

We repeat that it is true the South is advancing rapidly in these matters; but to those who might be inclined to think, from the preponderance of manufacturing news from that quarter, that the rest of the country was soon to be rendered of secondary importance in manufacturing matters, we would suggest going a little slow towards such a conclusion.

Now comes the time of year when the coal dealers—the small ones at least—begin to get in their work against the poor unfortunates who never have money enough to buy a half-ton of coal at one time—the poor unfortunates who buy by the pailful. Their coal costs them ten to twelve dollars a ton, against a little more than four dollars paid by the small dealer. The well-to-do buyer can stand the paying of the price of a ton of coal for seventeen hundred pounds, but it comes mighty hard for the poor devils to pay twelve dollars a ton for the little that keeps them warm. If some of the great philanthropic societies of our large cities would give more attention to providing means for poor folk to buy coal at a fair price, they would be doing a good work, and need not lose money in the enterprise either.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(473) F. E. S., Akron, Ohio, writes: Please settle a dispute by answering the following questions: Which is the correct way of polishing a piston rod? What I mean is, should it be finished lengthways or around? *A.*—We do not believe in draw-filing a piston rod. The best way to finish a piston rod is with an emery wheel while the rod is revolving on its centers.

(474) J. J., Indianapolis, Ind., writes: We are burning natural gas, and have a furnace fitted up with a superheated steam blast, that is to say, pipes run into the furnace re-heating the steam in these pipes; then they run out through the gas mixtures and back into the furnace. A. claims that steam used in this manner in proportion to the amount of gas used will give more heat than an air blast through the mixers gotten from a blower or any other air-pressure arrangement, which B. claims will give most heat. I would like to hear your opinion on this question. *A.*—We believe that B. is right—the heated air will give out the most heat, but whether it is advisable to use a blower will depend on the character of work done in the furnace, and the difference in cost of erecting and maintaining a blower.

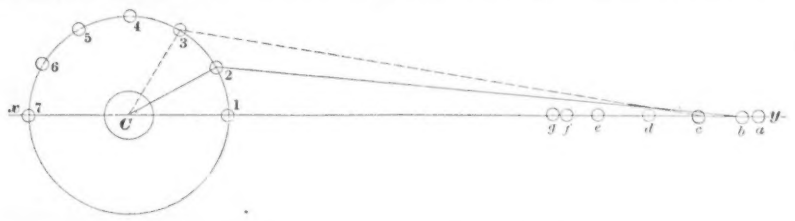
(475) R. C. C., ——, asks: Will you give me a rule for finding the size of cutters to cut gears of any size? For instance, I have a gear to cut that is $6\frac{4}{4}$ inches diameter, and it has to have 160 teeth, $\frac{1}{16}$ inch depth. What size cutter will I use? *A.*—We assume that you have given us the outside diameter of the gear instead of its pitch diameter, and that you have made a mistake as to the depth of the tooth. By dividing the number of teeth, plus 2, by the diameter given, we find that the gear is 24 pitch. The rule to find the thickness of the cutter at the pitch line is to divide 1.57 by the pitch, which in this case gives us .065 inch. The working depth of the tooth is found by dividing 2 by the pitch, which in this case gives $\frac{1}{12}$ inch, and the total depth is this, added to $\frac{1}{10}$ the thickness, which gives practically .09 inch for the total depth.

(476) D., New York, writes: A mechanic built a locomotive engine, had it tested to its fullest capacity, and the test proved successful. Then it was left standing idle for one year, the boiler not having received water or steam in it within the said period; and one severe cold night the dome blew off the boiler without any apparent cause. The dome was bolted on, not riveted. Can you explain the cause of said explosion? *A.*—We cannot explain the cause without knowing more of the locomotive. You do not say whether it was simply a model of a locomotive; we are inclined to think it was. If so, what kind of fuel was used? Where was the locomotive kept? What were its surroundings at the time of its explosion? Who had access to it? Give us a description of the locomotive, and all the data you can think of.

(477) A. M., Ottawa, Canada, writes: I have a compound engine; the high-pressure cylinder is 4½ inches diameter; low-pressure cylinder, 7½ inches diameter, and stroke of both is 6 inches. A gentleman advises me to reduce the high-pressure cylinder to 3¾ inches in diameter. He says that I will develop as much power as I do at present with the pressure remaining the same, namely, 110 pounds. What would you advise? If you do not think the engine will develop the same power with the same pressure, how much increase of pressure will be required by reducing the diameter to 3¾ inches, so as to give the same power as at present? *A.*—We cannot advise you in the matter, because you do not state at what point steam is cut off in the high-pressure cylinder, neither do you state whether the engine is condensing or non-condensing. We believe a diameter of 3¾ inches for the high-pressure cylinder is a better proportion than 4½ inches.

(478) C. B. R., Buffalo, N. Y., writes: Kindly state in your Question and Answer columns, which engineer's reference book do you consider to be the best and most practical? My work is on machine designing (at present, engines). I want a book where the matter is condensed but not slighted. If you know of a condensed treatise on iron and steel, and other metals of mechanical use, that is intelligible to a person of ordinary common sense and moderately good education, I would be pleased to know its title, and where it can be obtained. *A.*—To become a successful engineer, more than one study must be pursued, and consequently more than one book is necessary. We do not believe it to be possible to write one book which will enable a person, even if he has the best education which can be obtained in our public schools, to follow the engineer's profession without a previous training for the profession, and considerable study of the different branches of mathematics and subjects appertaining to engineering. This of course need not discourage young men who have the ability for and wish to become engineers, and who cannot afford to go through college. These studies can be mastered at home, and the shop practice during the day will give them the necessary training and experience. Nearly all large cities have libraries which contain books relating to engineering. We should therefore advise you to make there such selections of books as you think you can master, and if any difficult mathematical problems present themselves, then procure a book which treats on that particular branch. In this way you will make a progress which will be lasting and beneficial, and, by the time you are competent to design any kind of machinery, you will have quite a library. We may say here, that many men fail to become good engineers because they slight, or do not give sufficient time to the study of the science of mechanics. This is an important study and should be thoroughly understood before other studies relating to engineering are taken up.

(479) P. F. F., Elizabeth, N. J., writes: Please tell me if the piston of a steam engine travels at a uniform speed. If it does not, please give the reason why it does not. *A.*—The speed of the piston is variable, and the reason for this variable motion will be seen in the accompanying figure. Let C be the center of the crank-shaft, and let the circumference 1, 4, 7, represent the path of the center of the crank-pin; the line $x\ y$ represents the center line of motion of the piston; and the distance from 1 to a, the length of the connecting rod. Divide the semi-circumference 1, 4, 7 into any number of equal parts, and thus obtain the points of division 2, 3, 4, 5, 6; these points represent the positions of the center of the crank-pin during one stroke. From the centers 1, 2, 3, etc., and with a radius equal to 1—a, the length of the connecting rod, describe short arcs cutting the line $x\ y$ in the points a, b, c, d, etc.; these points represent the positions of the center of crosshead pin corresponding to the positions of the center of the crank-pin; that is to say, when the crank-pin is at 1, the crosshead pin will be at a; and when the crank-pin occupies position 2, the crosshead pin will be at b; and so on in succession. The motion of the crank-pin is uniform, consequently, if it takes, say, 1 second for the crank-pin to move from 1 to 2, it will also take one second to move from 2 to 3, because these spaces have been laid off equally. But while the crank-pin moves from 1 to 2 the crosshead pin moves from a to b; and while the crank-pin moves from 2 to 3 the crosshead pin moves from b to c. Since the distances from 1 to 2 and from 2 to 3 are described in equal times, the distances from a to b and from b to c are also



described in equal times, and since the distance from b to c is greater than from a to b, we conclude that the motion of the crosshead pin is variable. Now, the crosshead pin and piston are rigidly connected, consequently the piston has the same motion as the crank-pin, and therefore has a variable motion.

(480) X., New York, writes: In your issue, July 3d, Question and Answer 264, after giving a certain formula for obtaining area of steam port, you end by saying: "These proportions do not apply to low-pressure cylinders of compound engines." If not, why? And what is the accepted theory and practice of the best marine engine builders regarding this matter? *A.*—There is no accepted theory in regard to this matter; some engineers use the same rules for finding the area of steam ports of the low-pressure cylinder in a compound engine as are used for the steam port area in the high-pressure cylinder; and many engineers make the steam port area in the low-pressure cylinder somewhat less. 2. Have any experiments been made and published to determine the best ratio of receiver to cubical capacity of high-pressure cylinder for compound engines? And what is that ratio? Also what is deemed the best practice in relation to ratio of the first or high-pressure cylinder to first receiver, and intermediate cylinder to second receiver in triple-compound engines? *A.*—In regard to this matter, Mr. A. E. Seaton, in his Manual of Marine Engineering, says: "The space between the valve of the high-pressure cylinder and that of the low-pressure cylinder, into which the steam exhausts from the high-pressure cylinder, should be from 1 to 1.5 times the capacity of the high-pressure cylinder, when the cranks are set at an angle of from 120 to 90 degrees. When the cranks are opposite, or nearly so, this space may be very much reduced. The pressure in the receiver should never exceed half the boiler pressure, and is generally much lower than this. It is usual to fit a safety valve to the receiver, loaded by a weight or spring to a pressure of 20 to 30 pounds per square inch; otherwise, owing to the large flat sides between the two cylinders, great risk of explosion would be run. This safety valve is usually of the same size and design as the cylinder escape valves. The receivers of three crank engines need not be nearly so large, as the cranks are usually at angles of 120 degrees; in case of triple-compound engines with the M. P. leading the H. P., a very small receiver will do. 3. The formula for steam ports, above referred to, however, is not what I use. I use $\frac{A \times S}{6{,}000}$ = port area; where A is the area of the cylinder, and S the piston speed in feet per minute. *A.*—In answer to Question 264, we have said: Some builders make the area of each steam port equal to one-tenth the area of the piston for a piston speed of 600 feet per minute. Your formula agrees with this, and it is generally used by marine engineers reduced to the following form: $\frac{D^2 \times S}{7{,}639}$ = steam port area, where D is the diameter of the cylinder in inches, S the speed of piston in feet per minute.

(481) C. P. L., Ishpeming, Mich., writes: Kindly inform me how to find the ratio of expansion of an engine at a given cut-off; I do not fully understand it. *A.*—If it is assumed that there is no clearance, we simply divide the length of the stroke by the distance through which the piston has traveled from the beginning of the stroke up to the point of cut-off; the quotient will be the ratio of expansion. To illustrate, let the stroke be 24 inches, steam cut off at 6 inches; we then have $\frac{24}{6} = 4$, which is the ratio of expansion. Of course, if the stroke is taken in inches, the distance up to the point of cut-off must also be taken in inches; or, if the stroke is taken in feet, the distance up to the point of cut-off must also be taken in feet; for instance, if, in the example, we take the stroke at 2 feet, then the cut-off will occur at .5 feet, and $\frac{2}{.5} = 4$, which gives us the same ratio of expansion as before. Sometimes the stroke is taken as a unit, and the distance up to the point of cut-off is given in fractional parts of this unit. If, in the foregoing example, we call the stroke 1, then the cut-off occurs at ¼ of 1; now, following the same rule as before, namely divide the stroke by the distance up to the point of cut-off, we have $1 \div \frac{1}{4} = 4$. Take another example: Let the stroke be 24 inches, cut-off at 16 inches; then the ratio of expansion will be $\frac{24}{16} = 1.5$; or $2 \div 1\frac{1}{3} = 1.5$; or $1 \div \frac{2}{3} = 1.5$. Here it will be noticed that the ratio of expansion has been found by the same rule; the only difference in the three computations is that different units have been adopted for each. From the foregoing it will also be easily perceived that, when the cut-off is given in fractional part of the stroke, for instance, when it is said the cut-off occurs at ⅔ of the stroke, we have only to divide the denominator by the numerator, and the quotient will be ratio of expansion. If the cut-off is said to be at ¾ of the stroke the ratio of expansion will be $\frac{4}{3} = 1.333+$. But in all engines there is a clearance; by clearance is meant, not simply the space between the piston and the cylinder head at the end of the stroke, but it is the volume included between the piston when at the end of its stroke, and the valve seat; it includes the volume of the steam passage. This clearance is sometimes called *engine* clearance, to distinguish it from the clearance between the piston and cylinder head only, which is called *piston* clearance. For accurate computations, the engine clearance must not be neglected. Hence, when clearance is taken into account in finding the ratio of expansion, we proceed as follows. We must first compute the volume of the clearance; this is often a difficult matter, hence some engineers move the piston to end of its stroke, and fill the space up to valve seat with water, and in this way obtain the number of cubic inches in the clearance. The clearance is usually reckoned in per cent. of the piston displacement. Suppose now that this clearance is equal to 5 per cent. of the piston displacement, and that the stroke of the piston is 24 inches, then the clearance will be equal to a cylinder capacity whose length is equal to

$$24 \times .05 = 1.2 \text{ inches.}$$

Let the steam be cut off at 6 inches of the stroke, then to find the ratio of expansion we add 1.2 inches to the stroke, and 1.2 inches to the distance up to the point of cut-off, and proceed as before; thus

$$\frac{24 + 1.2}{6 + 1.2} = 3.5,$$

which is the ratio of expansion, with the clearance taken into account. If the steam is cut off at 16 inches, the stroke and clearance remaining as before, we have

$$\frac{24 + 1.2}{16 + 1.2} = 1.465,$$

which is the ratio of expansion. In all these cases it has been assumed that the exhaust is not opened till the end of the stroke. 2. Should a tubular boiler be set on a level, or on an incline? *A.*—It is always advisable to set the back end of the boiler a little lower than the front end, so that all the water can be blown out through the blow-off valve when it is necessary to do so.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Friday morning for the ensuing week's issue.

Grant's (1891) gear catalogue ready. See adv. p. 20.

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De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

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One book sells another, and that proves the value of the work. "I have one myself, and want one for my fireman. Enclosed find M. O. for $2.50." Jas. Hornby. See also AMERICAN MACHINIST, Oct. 23, for review. "Calculations" for engs., firemen and machinists $2.50, or 10 parts 25 cents each. Theo. Audel & Co., pubs, 91 Liberty St., N. Y., Catalogue.

Just Ready—New Catechism of the Locomotive. The most complete treatise on the construction and operation of the locomotive, by M. N. Forney, M. E. 688 large pages, with 488 engravings, 6 large folding plates, and 20 full-page plates of various styles of locomotives. Sent by mail, free of postage, $3.50. Frederick Keppy, Scientific Book Publisher, Bridgeport, Conn.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

MANUFACTURES.

A steel plant is reported as to be established at New Castle, Va.

A northern company contemplates locating pipe works in Pineville, Ky.

Liddell & Co. are about to build a large machine shop and foundry at Charlotte, S. C.

The Coatesville Iron Works has been formed at South Coatesville, Pa.; capital, $50,000.

The Alabama Pipe Company has commenced the erection of pipe works at Bessemer, Ala.

The Raleigh Street Railway Co., Raleigh, N. C., is reported as to erect an electric light plant.

Pennsylvania capitalists are investigating with a view of erecting car works at Radford, Va.

The Chattanooga (Tenn.) Car and Foundry Co. are rebuilding their foundry, lately burned.

The Ingersoll Milling Machine Company has been incorporated at Rockford, Ill.; capital, $6,000,000.

Smith & Burdette, of Cincinnati, O., are reported as to establish branch pipe works in Bristol, Tenn.

The Moffat Manufacturing Co., of Chester, S. C. is adding an iron foundry to its implement factory.

Cox & Morrison, Wheeling, W. Va., will, it is stated, erect a new building for their boiler works.

A foundry and machine shop have been added to the Eward Rash Iron Railing Works, at Florence, Ala.

The Batesville Iron Works will probably add an iron foundry to its machine shops, at Batesville, Ala.

The Union Electric Company has been incorporated at Birmingham, Ala., with $50,000 capital stock.

The Wheeling & Elm Grove Railway Co. will soon begin the erection of machine shops at Wheeling, W. Va.

The Centralia Iron and Brass Co. has been incorporated at Centralia, Wash., with a capital stock of $25,000.

The Mossy Creek Foundry and Machine Co., Mossy Creek, Tenn., will put in additional machinery.

The Ridgeport Land Improvement Co. have, as is reported, decided to build a rolling-mill at Ridgeport, Ala.

The Ingersoll Mining Machine Co., of Cleveland, O., will remove their plant to Rockford, Ill., at an early date.

The Shenandoah Valley Railroad Co. (office, Roanoke,) will build car shops in Shenandoah, Va., so it is said.

The Tacoma (Wash.) Foundry and Machine Co. are erecting a large bolt shop in connection with their works.

The Louisville, St. Louis and Texas Railroad is purchasing new machinery for its machine shops at Cloverport, Ky.

At St. Joseph, Mo., the St. Joseph Bridge and Boiler Works has been incorporated, with a capital stock of $42,000.

The Rollstone Machine Co., Anniston, Ala., contemplates increasing its capital stock and building an iron foundry.

Jacob Schuehle will, it is stated, erect a factory for the manufacture of his patent ice machinery at Dublin, Texas.

The Birmingham Iron Foundry Co., at Birmingham, Conn., contemplates building another foundry in the spring.

The Cahill Iron Works, at Chattanooga, Tenn., is reported as enlarging and increasing the capacity of its iron foundry.

The proposed Corpus Christi & South American Railway will, it is reported, erect machine shops in Corpus Christi, Tex.

The Chattanooga Machinery Co., Chattanooga, Tenn, is reported as to put additional machinery in its machine shop.

A company is reported organizing at Mexia, Tex., for the purpose of establishing agricultural implement works at that place.

The Virginia Car Co., Glasgow, Va., has commenced the construction of an 80x905-foot building for its steel car works.

A tack factory and wire-nail works will be removed to Front Royal, Va., and a stock company organized to operate them.

A company is being organized at Covington, Va., by W. A. Rinehart and others, to establish an iron foundry and machine shops.

The branch of the Cambria Iron Co.'s works, located at Cumberland, Md., is being enlarged, and new machinery will be put in.

The Richmond & Petersburg Railroad Company are reported as to erect new machine shops and roundhouses at Manchester, Va.

The East Tennessee, Virginia & Georgia Railroad Co. (office Knoxville, Tenn.,) will erect machine shops in Rome, Ga., it is reported.

An eastern party is investigating with a view of establishing a 75-ton rolling-mill in Birmingham, Ala. J. F. Johnston can give information.

A steam plant is to be established at New Castle, Va. The Junction City Land and Improvement Company are at the head of the enterprise.

The Virginia Car Company has commenced operations on the construction of its car works at Glasgow, Va. The plant will be 905x80 feet.

At Bristol, Tenn., according to report, Mr. Farnesworth will organize a $25,000 stock company to erect an iron foundry and machine shops.

The city of Maysville, Ky., will hold an election on December 15th to decide as to the appropriating of $20,000 to secure new industrial enterprises.

The Florence Land, Mining and Manufacturing Co., Florence, Ala., is negotiating for the construction of an iron furnace, rolling-mill and pipe works.

W. S. Creighton, Louis Sherfersee, W. S. Kay and others have incorporated the Rock Hill Machine Co., and will establish machine works at Rock Hill, S. C.

J. D. Tanner will, it is stated, establish works at Lynchburg, Va., for the manufacture of the J. T. Smite patent safety non-freezing tank for locomotives.

The Goshen Car and Railway Equipment Co. are a new organization at Goshen, Va., who are preparing to build a car works and manufacturing plant.

Northern capitalists have purchased, it is stated, $10,000 worth of land in and around Mascot, Tenn., and will build a new town and construct a steel plant.

The old Staunton Iron Works property at Staunton, Va., has been purchased by William E. Craig for $10,000, and will be improved and put into operation.

The Basic City Development Co., Basic City, Va., has purchased a tract of land adjoining the city for $68,000, and it is said that iron-working plants will be erected.

A tannery, steel works and stove foundry are reported as to be established at Graham, Va. The Graham Land and Improvement Company is interested.

A Pennsylvania company is corresponding with a view of locating an iron foundry and nail-mill in Pineville, Ky. The Pine Mountain Iron and Coal Company is interested.

The organization of a $25,000 stock company to establish works for the manufacture of car axles, shafting, etc., is talked of at Dallas, Texas. Alderman Hughes is interested.

The Barton Agricultural Works, of Sheffield, Ala., are removing their agricultural implement factory to Tuscumbia, in the same State, and will erect additional buildings.

C. A. Blessing, of Philadelphia, has purchased the old Salem iron foundry, at Salem, Pa., and will take possession in a short time. The foundry will give employment to 75 men.

The Crucible Iron and Steel Works, East St. Louis, Ill., will nearly double their capacity by the erection of a new foundry 100x64 feet. The improvement will cost $100,000.

It is stated that the Carter Machine Co., Danville, Va., will be organized, with a capital stock of $150,000 for the purpose of manufacturing the Carter perfection cigarette machine.

The Scoville Iron Works has been incorporated at Chicago, Ill., to conduct a foundry and machine shop; capital, $75,000. Incorporators, Hiram H. Scoville, Frank B. Macomber and D. D. Drummond.

J. W. Pike & Co., manufacturers of knitting machines at Little Falls, desire to locate in Amsterdam, N. Y. It is likely that the board of trade of the latter place will offer some inducement to the firm.

Rockford, Ill., is figuring for the removal to that city of the Standard Foundry and Manufacturing Company, of Cleveland, Ohio, which gives employment to 250 men and daily melts 20,000 pounds of iron.

The Taylor Manufacturing Co., Chambersburg, Pa., has closed a contract for the removal of its engine works to Bedford City, Va., and a $200,000 stock company is to be organized to operate the plant.

Messrs. J. G. Allan, of Hamilton, Ont., and R. J. Hay, of Cleveland, O., are erecting a factory in the former city for the manufacture of foundry facings. They expect to have it in operation in a few weeks.

The Fulton Machine Co., with a capital of $33,000, has been formed at Syracuse, N. Y., for the purpose of manufacturing the Kendrick feed cutter, the Shepard pulley, and to do general machine and foundry work.

Cooke's Safety Switch and Railway Improvement Co. has been incorporated at East St. Louis, to manufacture a safety switch; capital stock, $100,000; incorporators, E. J. Crandell, W. G. Parkhurst, C. C. Whitney.

The Pennsylvania Foundry and Machine Co., of Pittsburgh, will soon be chartered by Theodore Doerflinger, George P. Lesche, William J. Woods, F. C. Miller, Morton Hunter and John M. Griffin. The foundry will be located in Pittsburgh.

The Grand River File Company, of Chicago, Ill., has been incorporated, to manufacture and sell files and file machinery. The company has a capital of $800,000. The incorporators are: Gideon E. Meigs, E. L. Shepard and Justin J. Wetmore.

The McCloud Iron and Steel Company, of Chicago, Ill., has been incorporated by S. McCloud, F. G. Holton and W. D. Crossman. The company will manufacture iron and steel articles for railway use. The amount of capital stock is $100,000.

The Van Auken Steam Specialty Company, of Chicago, has been incorporated, for the manufacture of brass, iron and steel specialties; capital stock, $25,000; incorporators, Clarence E. Van Auken, Byron E. Van Auken and Charles P. Monash.

Messrs. Westinghouse, Church, Kerr & Co., of Chicago, have purchased the old plant of the Cragin Manufacturing Company in the northwestern part of the city, and will refit the factories for the manufacture of engines, employing about 100 men.

Champaign, Ill., is soon to have a new industry in the form of a first-class foundry. Robinson & Burr are the moving spirits. The works will be 90x35 feet, two stories in height. The plant will be provided with the very latest machinery and appliances.

The Norristown (Pa.) Steel Co. are erecting new works at that place. The building is 150x50 feet, and the machine shop 100x45 feet. The main building will contain two modern 15-ton hearth furnaces, and a steam traveling crane of 20 tons capacity.

To the industries of Salem, Va., are to be added a $100,000 car works, a $100,000 rolling-mill, a $75,000 muck-bar-mill, a $75,000 cotton factory, and a $50,000 iron works. The Land and Development Companies of that city have combined to secure these plants.

A license of incorporation has been issued to another Chicago company whose object is tin plate and sheet-iron manufacture. The incorporators of this concern, which bears the name of the Chicago Tin Plate Company, are Richard J. Reis, George O. Manchester and S. W. Snow.

The Terre Haute Shovel and Tool Company, lately organized to operate the plant of the old Sanford Tool Company, are pushing work as rapidly as possible and getting into good shape to take care of all orders. Charles Minshal has assumed charge as treasurer and manager.

The Park Mfg. Co., Boston, Mass., manufacturers of injectors, ejectors, and jet apparatus, has, on account of large increase in business, moved into more commodious quarters, and added new machinery and a brass foundry. The office address has been changed to 51 Portland street.

There is water-works agitation in Davenport, Iowa; Fairport, N. Y.; Blue Springs, Neb.; Canton, S. D.; Harrodsburg, Ky.; Brooklyn, N. Y.; Argonia, Kan.; Gainesville, Fla.; La Harpe, Ill; Valdosta, Ga.; Sturgis, S. D.; Meriden, Conn.; St. Paul, Minn.; Dayton, Wash.; Cresco, Minn.; Butte, Mont.

The New Castle Steel Company, and the New Castle Wire Nail Company, both of New Castle, Pa., have consolidated, the new concern taking the name of the last named corporation. The capital stock was increased from $350,000 to $500,000. R. W. Cunningham, of New Castle, is president of the new company.

It is stated that the planing-mill of W. B. Farrar & Co., Ridgeville, Tenn., will be converted into car works, and that A. S. Glover, W. B. Farrar & Co., Mr. Tipton, of Dalton, Ga., and others will organize a stock company to operate same. Machine shop, blacksmith shop and car wheel foundry are to be included in the plant.

At a meeting of the directors of the Newnan (Ga.) Cotton-mills it has been decided to purchase $15,000 worth of new machinery. The order will be placed at once. This will increase the capacity of the mill about one-third. This step has been rendered necessary by the increasing demand for goods manufactured by these mills.

The Western Locomotive Company has been incorporated in the State of Washington, with a capital stock of $2,500,000, in $2,500 shares. John L Ayer, Joseph Hadurger and F. D. Burton are incorporators, and the purpose is to locate the principal works at Seattle. The company will manufacture portable engines of all sorts.

The town of Elwood, Ind., is to have a tin plate plant, according to dispatches from that place. The project is backed by Cleveland capitalists. The company is to get twenty acres of ground for its works, one good gas well ready drilled, and a perpetual lease on 2,000 acres of productive gas territory. The capital stock is named at $500,000.

The Kensington Steel Works Co. has been organized for the purpose of building a steel works at a new town that has been located recently on the Allegheny River near Parnassas, about 30 miles from Pittsburgh, Pa. The company expect to manufacture open hearth steel. A chain factory and a sheet-iron mill are already secured for the new town.

J. S. Clark, proprietor of Clark's foundry, South 11th street, Denver, Colo., has recently built a new foundry 46x86 feet, and has now bought six lots upon which to extend his foundry, and build a machine shop. Although comparatively recently established in Denver, he finds his business constantly pushing him, hence the necessity for further enlargement.

The Cumberland Gap (Va.) Iron Company is erecting a monster plant. The foundations have all been laid for the large buildings, which will include stock house, blast house and charcoal ovens. These ovens, 32 in number, are in a double row, with a railroad between, to facilitate the handling of ore and iron. This plant will manufacture charcoal iron, and will be of great capacity.

The Jefferson Iron Works, of Steubenville, O., will soon commence to rebuild their rail factory, recently destroyed by fire, and also the iron building covering the rolls, forge, engine, boilers and shaft. The building will be practically fire-proof, with iron pillars and girders, and the roof will be of corrugated iron. The structure will be 200 feet long, 80 feet wide, and 25 feet in height.

The National Pneumatic Tool Company has been formed at Portland, Me. Its purpose is to manufacture and deal in tools and machinery. The capital stock is $200,000. The officers are: President, Henry M. Cross, Boston; treasurer, Marcius Marx, New York; directors, H. M. Cross, Marcius Marx, A. E. Blackmer, Ernest Marx, H. W. Metzing, New York; Lewis Balch, Amesbury, Mass.; Isaac W. Dyer, Gorham.

A new corporation, the Aschman Steel Company, has purchased the works of the Evans Iron Company, in Sharon, Pa., and is remodeling them to serve as a steel foundry. Various alterations, additions and improvements are being made. The open-hearth furnace and annealing ovens are to be built by the S. R. Smythe and Laughlin Company, of Pittsburgh. The plant will be ready for operations early in January next.

The movement to establish an extensive wire nail plant in Omaha seems likely to be carried out within a short time. A. J. Sweeney & Son, of Wheeling, W. Va., propose to invest a considerable sum in the enterprise, and to operate the plant successfully for five years. They offer to lay out a plot of 240 lots, for which they will ask the Omaha Board of Trade to secure purchasers. As soon as these lots have been taken they will begin work on the mill.

The Lodge & Davis Machine Tool Co., with works at Cincinnati, O., and branch houses at New York and Chicago, where they carry a full line of their machine tools in stock, have just been awarded a contract by the U. S. Government for furnishing a large equipment for their improved engine lathes to the Watervliet Arsenal, West Troy, N. Y., to be used in turning up heavy projectiles. They say the demand for their improved machinery is growing daily, and they have lately made large additions to their force in order to keep pace with the demand for their tools.

It is an Evil.

The *Railway Telegrapher*, in an article in which attention is called to railroad collisions resulting from incompetent telegraphers, says:

The boy telegrapher, by general verdict of the public, must give way to the man. Experience has clearly demonstrated the fact that it requires something besides a mere knowledge of the technical formation of the telegraphic alphabet and the ability to transcribe a transmitted message from the telegraph—that emergencies frequently arise requiring the exercise of a matured judgment and an active mind in order to avert the loss of life and property and that the boy telegrapher is not possessed of these necessary qualifications.

In a recent accident caused by the boy telegrapher "losing his head," to use a common expression, resulting in the loss of life and great destruction, the evidence at the coroner's inquest established the fact that the boy, not seventeen years of age, received a compensation of $30 per month. No reasonable person would expect that any degree of competency could be purchased for such a price. The same rule holds in the employment of labor as in the purchase of merchandise—to procure a good article you must pay a good price. Cheap prices procure shoddy goods.

There is a deal of common sense in the above. It seems strange that railroad companies should, for the saving of a few dollars, employ mere boys in positions of great responsibility, but it is beyond question that they do so, although we doubt if they save any money in the operation. One first class smash-up on a road, caused by lack of experience which teaches men to act right and quickly, would pay the difference in wages between an experienced and an inexperienced operator for a good many years. But railroad companies are not the only ones that work on the cheap plan. They are to be found in about all branches of trade and manufacture. The man who will work for low wages, or the boy who can do, in a way, the work of a man, is being sought for in all departments of labor. As a means of keeping down the price of labor this may be a success, but it does not always reduce the cost of the economic result produced. And it has the effect of deteriorating the quality of labor obtainable, year by year.

A Galveston, Texas, dispatch says: Col. J. B. Clarke, of Chicago, representing a Chicago syndicate, to-day closed an agreement with capitalists here which means the establishment and maintenance of a new line of steamers between Galveston and South American ports. It has been decided to incorporate the company with a capital of $50,000,000. The stock will be held in Denver, Topeka, Kansas City, Omaha, Des Moines, Galveston and Chicago, the greater part of it being owned in the two cities last named. The title adopted is the Pan-American Transportation Company. The headquarters will be in Galveston.

Congress has done a very creditable act in authorizing the President to appoint Richard H. Jackson, of Alabama, an ensign in the navy. Young Jackson, having finished his studies in the Naval School, was sent on a two years' cruise, at the end of which a part of the class, under the law, was retired, and the others made ensigns. Jackson fell among those retired. But when he was on his cruise he distinguished himself so greatly that this special law has been passed to retain him in the navy. It was at the great storm at Apia, Samoa. At a critical moment, when the "Trenton" was about to drift on a reef, he led the men aloft, where their bodies had the effect of a sail, and this saved the ship. Admiral Kimberly highly complimented Mr. Jackson on his bravery in time of such

peril, and in a report to Secretary Tracy, says that he not only saved the "Trenton's" crew, but also that of the "Vandalia," who would all have been lost had not the "Trenton" drifted alongside and rescued her men. Mr. Jackson is only twenty-three years old, and was appointed to the Navy Academy by Gen. Wheeler, of Alabama, graduating in 1887.—*Raleigh News and Observer.*

Tool-room Kinks.

BY FRED H. COLVIN.

Large shops usually have tool-rooms to order, and a place laid out for everything—stock of steel and iron, as well as places for tools. But the tool-room referred to here, although it is as roomy as possible in the shop where it exists, lacks many of the details that a larger one might have, and, though cosy and convenient, is a good field for space-saving kinks to develop themselves.

No doubt many have used devices similar to those here mentioned, but some, perhaps, have not, and they may be of use to them.

Beginning with the stock of steel and iron, which, though not large, is necessarily varied, as the tool maker little knows what size will be next needed. We find it often piled in a corner, or box, or somewhere, either out of sight and unhandy, or in sight and unsightly. This was easily remedied by having a few pairs of hooks made, as shown in Fig. 1, and by hooking them over the steam pipes (radiating pipes) which ran along the wall behind the lathe, racks were formed which can be used in many ways. By keeping the round steel on one rack, flat on another, and similarly with iron or machinery steel, they are easy of access and no disfigurement to a neat tool-room. In case the steam pipes cannot be utilized, the hooks can be made to drive into the walls, or fasten to bench, partition or other woodwork.

Many have no tool board on the lathe, and you see tools lying on the ways, in window-sills, and on the bench; when one is wanted, a search warrant is necessary, and that means time lost. Of course, a tool board costs a trifle, and the best kind to have is one with a raised edge of about one inch, to keep tools from becoming displaced, and cleats on the bottom that fit in between the ways and hold it in place. The room at the tail of the lathe bed is not often needed on tool work, and if it is needed at times, the board is easily lifted off. But the cost is not to be compared with the convenience, and time it saves; every tool is in plain sight, easily reached.

Next come the lathe accessories, such as chucks, dogs or carriers, wrenches, centers, gears, etc. Some discard the board or shelf under the lathe, and substitute a trough, or leave it vacant, but compactness and convenience again seem to say, better have it. But the chips and turnings dropping through on the shelf make it uninhabitable for any well-bred chucks or other tools, so we hang an iron trough or pan close to the bottom of the lathe-bed, thus shielding the shelf and catching the chips, also keeping them off the floor. On this shelf are kept the chucks belonging to the lathe, the steady rest and small face plate when not in use; the large one, seldom used, is hung against the wall, by a hook, out of sight, though easily got at.

Now for the dogs, wrenches, etc. A large board, nailed to the wall at the head of the lathe makes a convenient place, and large, round head screws (blued) make excellent pegs for holding, as the head keeps anything from slipping off. The dogs can be arranged in order of sizes, and the right one selected at once. The trouble of hanging them up when through with them is no greater than throwing them under the bench, or on it, if any one just thinks a little. Below these the wrenches are hung, such as will hang, while open wrenches are held in loops or pockets, made by fastening a narrow belt in loops, similar to a cartridge belt for gunners. The lathe centers are held in a similar manner, either on this board or a more convenient place, if there is one. On this same board, if large enough, or on one beside it, is where the "change gears" find resting place, and the same kind of screws make good pegs for them also. Standing by the head of the lathe, the tool maker can reach any dog, wrench, change gear or lathe center, as well as his drill chuck and center reamer.

The lathe bed under the tool board, where it is protected from chips, is also utilized for tools only occasionally used, by fitting a board in for a bottom, which can be easily done on many engine or tool makers' lathe.

Many do not seem to appreciate a compound rest as it deserves, probably in part due to the work in hand not requiring its use. To rightly appreciate it, one wants to work on tools for valve seats, or reamers where the taper at parts vary from 15° to 90°, and each taper must be very close to the angle given. And here, as well as in turning tapers between centers, the rule of setting the tool point at the center line (in height) must be observed for accurate work. The reason is obvious to nearly every one, and has been explained too often to need repetition here. For turning lathe centers, and grinding them after hardening with the tool-post grinder, it is also very useful; in fact, many cases of extreme usefulness might be cited, yet on work not requiring it the additional parts may seem objectionable.

Speaking of lathe centers brings to mind the custom many have of using a soft live center. It is easily trued up, to be sure, and much more easily "untrued" than if hardened, and where a tool-post grinder is at hand, it is much easier to true up a hardened center than a soft one without it.

Fig. 2 gives a few centers that are indeed useful, beside, of course, the regular lathe centers, and, where possible, it is best to have two pairs; for, should one happen to break or become untrue during a hurried job, it is much better to pick a new one out of the rack than to stop and make one. Then, too, it sometimes happens that an extra particular job is on hand, and the "spare" centers are

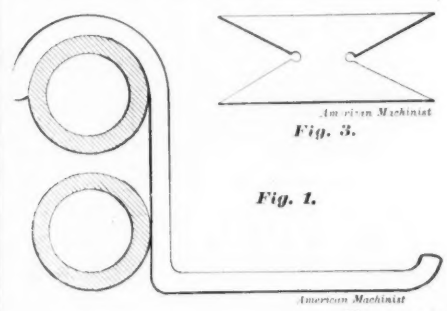
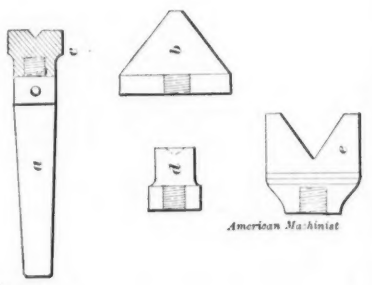


Fig. 3.

Fig. 1.

Fig. 2.



TOOL-ROOM KINKS.

dead true, while the others may be worn slightly, though all centers can be kept true with very little trouble.

Referring to the cut, *a* is a combination center; the center proper is threaded on the end for the parts shown; *b* is a pipe center, or for similar work; *c*, *d*, *e*, drilling caps that can be screwed on for different work; *f*, an arm, or overhang, that is sometimes used in drilling offset holes and other uses that present themselves in practice more than in writing of them. The square center is well known, and has its own field of usefulness.

It is often quite a job to set a lathe "straight" after the tail-stock has been "set over" for taper work, and generally it requires a little "cut and try" to get it just right. Of course a mark is very handy to set to, but it seldom brings the centers just right, and while an actual test by turning is the only exactly sure way, perhaps, we can come very close to it by "matching" the centers; but reflected light is often deceptive, and here it generally is. I have been thinking of a "center gauge" like Fig. 3—why would it not help set the lathe approximately ture, and be a help in other work of a similar nature?

It often happens that a tool maker has not time to thoroughly clean his room, tool shelves or racks; such work takes time; when you take out each tool, dust the shelf, and after wiping it, replace it in its proper place. But dust will accumulate, and must be removed, or it distigures the shelves. So, when not having time for a thorough house-cleaning, just take a bellows—borrow it from the foundry if you have none handy—and see how it cleans out the dust from between the tools. It will not clean as thoroughly as wiping and brushing each tool and place, but it will help when one is hurried, and is much better than no dusting whatever. I only advocated borrowing for the experiment; if you like the way, just tell the proprietor that one would save you much time, and, as time means money to him, he isn't apt to refuse if he is an enterprising man.

A little "wind" helps in other ways, too—not talking, particularly—but when boring out inside work, especially when it is cast-iron, it is of great value. When we blow into a bored hole to clean out the chips or borings, we get them in the face, and, unless we close them, the eyes, too. It improves neither, and often seriously injures the eyes. A piece of small copper or other tubing, with one end bent for a nozzle, makes a good arrangement, and does the work more effectually, as the blast is centralized and can be directed to any part of the chamber.

One of the most common articles on the repair list are universal chucks, for they are tender at best, and do not often get the best kind of care or treatment. This is especially true of brass-working shops, where the fine chips or "feathers" float into the internal organs of the chucks, accumulate on the rack, and are pressed firmly down as the chuck is used, and the pinions on the screws roll over them. Finally the screw sticks, and here is the time when it should be returned to the tool room for repairs; but it seldom is. When it begins to stick, the workman applies more pressure, and finally it comes in with a large amount of dental work to be done—false teeth to be inserted and then "trued up" again. If, when the chuck begins to work hard, it was returned to the tool-room, a few moments would make it as good as new; cleaning is all that is required, and some shops insist on this, and consequently chuck repairs are reduced greatly. The trouble often comes from using a large wrench on a small chuck, expecting a 6-inch chuck to do the work of a 12 inch one; it doesn't very often, however.

It has always seemed to the writer that for regular work, where like pieces are to be held by hundreds, a universal chuck was of little account. For take a round piece of work, and after setting a three-jawed independent chuck for that size, lock two jaws and use the third one; it holds every piece just alike, and does away with the frail rack and pinion arrangement so much used. For repair work, where odd-size pieces are apt to come in, and absolute centering is not required, the universal chuck answers very well, but in the majority of work the independent chuck stands far ahead.

Oil should not be used in a chuck for brass work, as the brass dust always collects in any moisture, and is more apt to clog. For a lubricant, use graphite, or black lead, as it is usually called.

If men would calculate what strain they exert on a chuck-screw when using a 9-inch wrench, there would be less wondering when it broke, and less condemnation of the quality of steel.

As each one has a method of his own for "truing" a universal chuck, it may not be amiss to give one or two here. One method, and the best I know of, is to take out the rack, and, putting the chuck together, run it as an independent chuck. True up a piece of steel, or any metal, and while the jaws grip the piece in a central position, remove the back and put the rack in place. This is reasonably certain, and usually works the first time; but when there is much slack in any of the jaws, the slack jaw may give a little trouble.

Another similar method is to run a true mandrel between centers, and true the chuck jaws on, placing the rack on as before. This takes longer than the first method.

Economy is to be considered in the tool-room as elsewhere, and much work, time and money can be saved by attention to details. When making any bar with mortised cutters, plan everything so as to use commercial sizes of steel. Then when a cutter breaks, and the job waits for it, you don't have to plane, file or grind down steel to some special size, but can cut a piece off the regular size bar, and have the job done in half the time. And this applies to nearly everything; for where commercial sizes can be used, be it bolts, steel, rivets or anything in the line, it is much cheaper to use the regular market article than to make them yourself, unless you are in that business. A little forethought in this respect may save considerable time and money, and will be appreciated in most cases.

Building the Shop Floor.

I read, with much interest, Benj. F. Wilson's suggestions on "Building a Small Machine Shop." His ideas are good, every one of them, except the grand "climax." That, I think, is faulty, and Mr. Wilson would think so, too, if he could see a few floors that are put down as he says.

The shop floor, above all things, should be substantial and solid, and it is just as important for it to be solid the twentieth year as it is for it to be solid the first year.

Before I write more, let me inform your correspondent that I can't help him in the selection of a "self-oiling hanger." Now for the floor. A floor with its foundation bedded in the ground, and the flooring resting on the ground, would not last over ten years, neither would it remain solid over six years. This alone should condemn any such plan, unless the shop owner is willing to go to the expense of moving the machinery and re-flooring the shop. Every experienced mechanic knows that just as soon as the floor becomes unsteady, and the machines begin to rock and shake, right then they begin to wear and break down, and to produce unsatisfactory results. I can point Mr. Wilson to a few shops with floors built on his plan, and if he will devote just five minutes to conversation with the owners he will invent another plan and forever banish his present one.

The most satisfactory shop floor I have ever seen was made of 1½″x6″ hard pine flooring, set 18″ above the ground, and supported underneath by brick tiers 24″ apart, running the whole width of the building. A 12″ space for ventilation is left every ten feet in each tier. Ventilators 8″x8″ are used—or rather put in—12 feet apart around the building.

This floor can be called an improved shop floor, as it is the result of an experiment made with one of Mr. Wilson's kind of floors, which lasted about half as long as it would have lasted had it been properly built at first.

An important suggestion on shop building has been omitted: Be sure to build a good, solid foundation under each machine. The wear of the machinery will more than pay for it.

AN OBSERVER.

It is getting to be something of a regular thing to see in the papers some mention of trouble between the employes of the Clark Mills, and the superintendent, Walmsley. The mills are located at Newark and Kearney, N. J., and Walmsley was brought over here from England or Scotland to superintend them. A year or more ago, the girls employed there became so deeply incensed at his treatment of them, that they quit work in a body; one girl having fainted in the mill, after having asked and been refused permission to go home on account of sickness.

There has been trouble again recently, and the men complain of the treatment received from Walmsley and his overseers, whom they charge with applying opprobious epithets to them. One man was cursed by an overseer for leaving his machine a few steps to get a wrench, and when he complained to Walmsley about it, was discharged. It must be confessed that some of the customs of the "wild and woolly" West possess advantages over those of the effete East. There such a being as Walmsley would be waited upon by a committee of citizens, who would call his attention to the propriety of getting back where he came from, and their arguments in favor of that course would probably be very convincing. Walmsley seems out of place here, at any rate.

Since the above was written, the papers announce that trouble has again broken out on account of the peremptory refusal of Walmsley to meet and talk with a number of employes, who had not struck nor done anything except to ask for a conference. It seems a pity that such a man should be able to tyrannize over decent citizens of America.

One of the New York papers calls attention to the value of the proposed bridge across the North River to those whose business requires their presence in the city every day, and who must then live somewhere in or near it. It says that "there is plenty of land opposite New York that is a drug on the market at $1,000 an acre, and yet is as near the center of the city as hundreds of sites that are being seized at $1,000 per lot (25 by 100 feet), for the erection of dwelling houses. With a bridge across the Hudson, the possible extension of New York's tributary population would be very largely increased, and thousands of homes could be occupied by families now huddled together in tenements, or left at the mercy of fogs and ferryboats."

A point not touched upon by our contemporary, however, is the fact that in all human probability, to judge from past experience, the efforts of rival speculators in this land opposite New York will be one of the greatest obstacles to the building of the bridge, and it will no sooner be finally located, and work commenced on the foundation for the piers, than these same speculators will begin to take in what will eventually be the largest share of the benefits to be derived from it. There is scarcely an engineering work of any magnitude that is not handicapped by the efforts of these real estate operators to reap all the benefits; efforts in which they are usually pretty successful.

The first page of a recent issue of one of the illustrated weeklies contained a cartoon which vividly portrayed the condition of affairs which we some time ago pointed to as the probable result of the increasing employment of women and children in work which should be done by men earning sufficient to support families in at least moderate comfort and decency.

The cartoon showed a squalid home, from which the bread-winner (who, in this case, was the wife,) was just starting forth to her day's work as conductor on an elevated railroad train. The semblance of a man—her husband—stands with a broom in hand, and with crying children about his knees, is receiving the wife's parting injunction to mind the children and have dinner ready on her return.

The picture, we suppose, owes its origin to the fact that on the Brooklyn elevated roads women are replacing men as ticket-sellers, the officers taking pains, however, to declare that the wages paid will be the same, which they may be for the present. But how will it be when women have fully supplanted men in those positions? We think the company is trying women because it expects in the end to secure their services cheaper than those of men, and the result of all such changes can but be worse for both the men and women who must live by such work.

Machinists' Supplies and Iron.

NEW YORK, December 13, 1890.

Iron—American Pig—No improvement in the general situation has taken place since our last report, the continued financial stringency causing a good deal of conservatism on the part of buyers. The demand has been almost entirely confined to that of a hand-to-mouth character, and there has been practically nothing done in the way of contracting for future wants. Quotations, which are somewhat nominal, are as follows:

No. 1 Foundry, standard Northern brands, $17 to $18; No. 2, $16 to $16.50; Grey Forge, $15 to $15.50; Southern brands No. 1 Foundry, $16.50 to $17; No. 2, $15.75 to $16.

Scotch Pig—Sales have been very limited and quotations are nominal only.

We quote Coltness, $24.50; Dalmellington, $22 to $22.50, and Eglinton, $20.50.

Copper—The market has been weakening, and there is every indication of a supply far in excess of the demand. It is reported that the Calumet and Hecla Co. will pass the December dividend. Very little fresh business has been done, though Lake has been obtainable from outside parties at 15¼c. to 15c¼. for prompt or near delivery. Casting brands are nominally at 14c.; Arizona, 14¾c.

Lead—Prices have still further declined, and the market is very much unsettled, though a fair amount of business has been done at the lower prices. Values range at about 4¼c. to 4½c. in job lots.

Spelter—The market has been quiet, and there has been very little trading except to supply current needs.

We quote ordinary brands of Western at 5.90c. to 6c.; choice, 6⅛c. to 6¼c.; refined, 7¾c. to 8c.; Silesian, 7⅜c. to 7½c.

Tin—There is some scarcity of supplies on hand here, and this has caused a firm feeling here, though quotations have declined in London. Prices are at 21⅛c. to 21¼c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue

Wanted—Two irregular die makers. Address Ferracute Machine Co., Bridgeton, New Jersey.

Exp. foreman of mach. shop, building heavy machinery, desires to change. O. H. B., AM. MACH.

Situation by young man as pattern maker while attending Cooper Institute. W. F. W., AM. MACH.

Wanted—Three first-class machinists on new work and repairs. Frank Harlow, Waterloo, N. Y.

Wanted—A first-class temperer. Chester Twist Drill and Tool Co., Chester, Pa.

Wanted—Position by a practical boiler maker, as foreman; sober and steady man; good references. Address J. H. C., AMERICAN MACHINIST.

Wanted—A good, first-class draftsman on stationary engine work. Apply by letter, stating qualifications, to Erie City Iron Works, Erie, Pa.

Wanted—A good machinist for general work; good wages, steady work, weekly pay. Ronceverte Machine and Foundry Co., Ronceverte, W. Va.

A mechanical engineer, A1 and reliable, desires a position, steel works, machine tools and general practice. "Steady," AMERICAN MACHINIST.

Mechanical engineer, skilled in drafting, estimating, manufacturing and construction, desires engagement. Box 321, Chicago, Ill.

Wanted—A competent man as foreman in a machine shop, must be a good draftsman and capable of handling men, also in getting out 1st-class work promptly. Address M. E. B., AMERICAN MACHINIST.

Wanted—A competent engineer to take charge of a Brown engine. Must be a steady and reliable man. Address, stating age, experience, references and wages, S. W., AMERICAN MACHINIST.

American, aged 30, graduate of Eastman's Bus. Col., Poughkeepsie, now employed by Western Electric Co., wishes position in business house where he can advance; good draftsman; iron works preferred; good refs. Box 17, AM. MACH.

Wanted—Superintendent for machine shop, foundry and boiler works; one who is familiar with all branches of the business, is a good draftsman and designer, and can handle men. State experience and salary expected, and give references. Address "Superintendent," care of AM. MACHINIST.

Superintendent—A competent mechanical engineer with good record, now in charge of large works, wants to make a change. Good manager of men; well acquainted with best shop practices and systems. Experienced in marine and stationary engines and boilers, and general machine work. Address A. H. R., 144, AMERICAN MACHINIST.

A well-known firm in New York wants a first-class man as superintendent of its brass foundry and finishing shop, employing 60 to 75 men. Address, giving previous experience, references, and salary expected. The right man can, in time, obtain a profitable interest. Box 18, AMERICAN MACHINIST.

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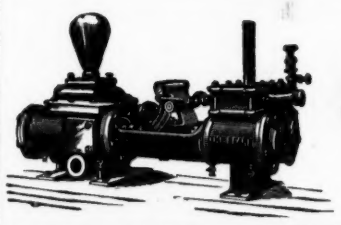

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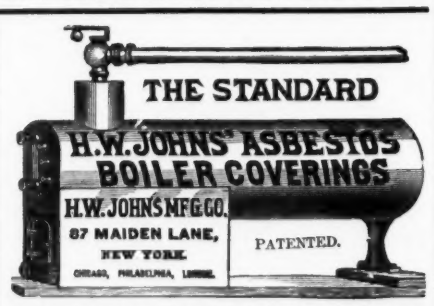

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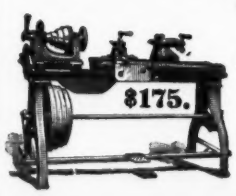

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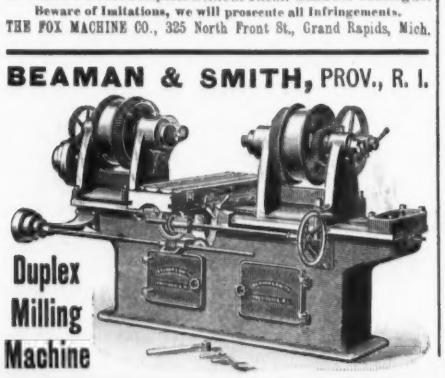

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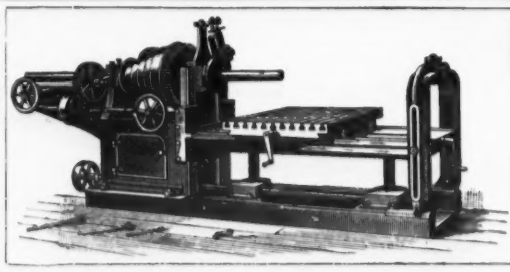

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Wanted—Customers for our new Radial Drills, C. H. Baush & Sons, Holyoke, Mass.

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Full size blue prints, of nine inches swing bench lathe; plain pattern, wood cone, price, $1.00; fancy pattern, iron cone, $1.25; do, with carriage, $1.75. I. I. Farrar, Paterson, N. J.

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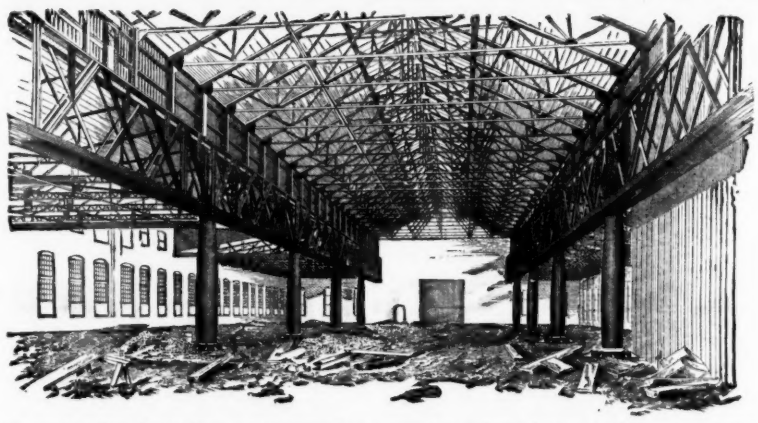

The above cut is taken direct from a photograph of a foundry building lately built by us for The Farrel Foundry & Machine Co., at Ansonia, Conn. The building is 126 ft. in width by 300 ft. long and is designed for making the heaviest castings. The girders supported by cast-iron columns shown in this illustration are designed to carry a traveling crane back and forth the whole length of the building, the cranes having a capacity of 50 tons each. It is also designed to place a jib crane half way between these large cast iron columns, which will control the space between the columns and the outside walls. The wing trusses are also designed to support a 5-ton jib crane at any point in the wings, so that when all the cranes are placed the whole foundry floor will be completely and entirely controlled by power. This is probably the best designed and equipped foundry to be found anywhere in the United States.

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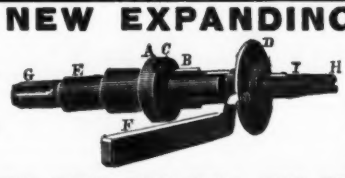

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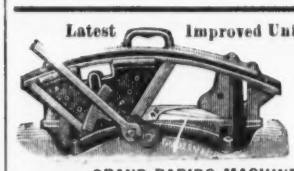

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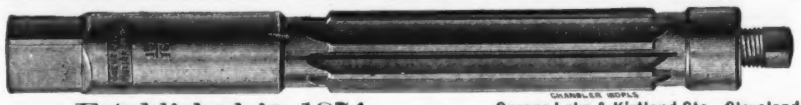

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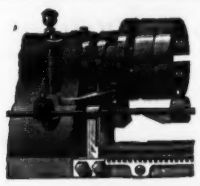

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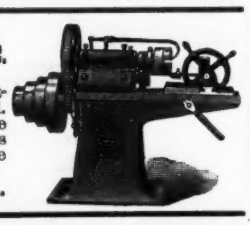

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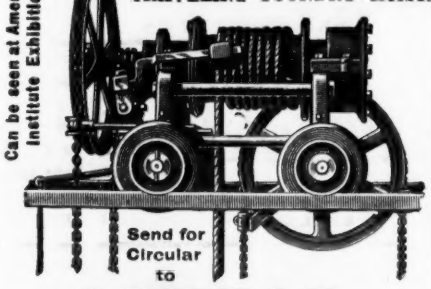

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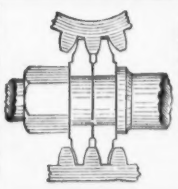

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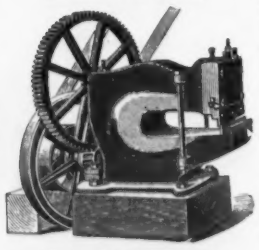

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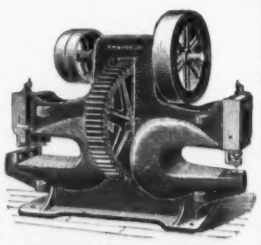

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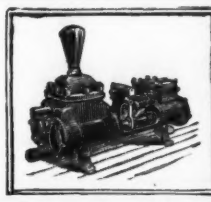

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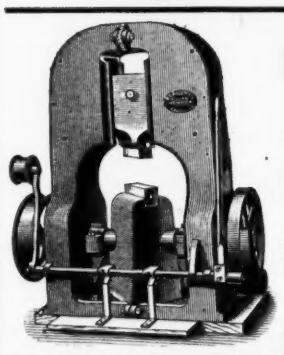

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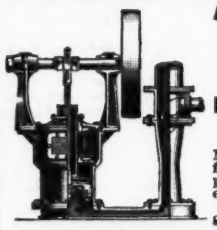

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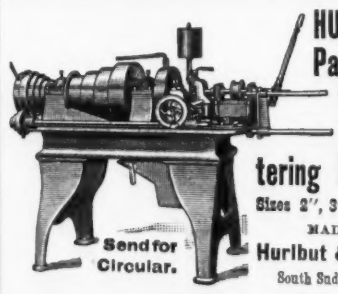

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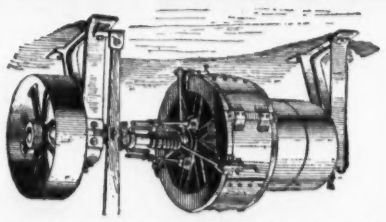

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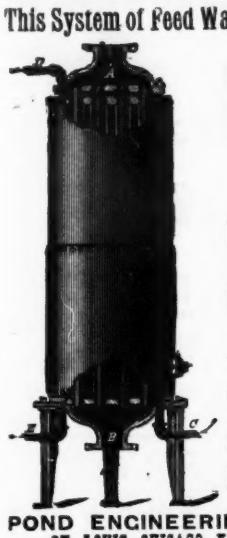

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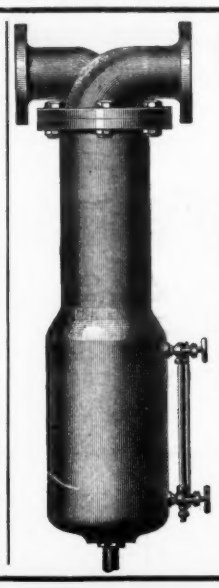

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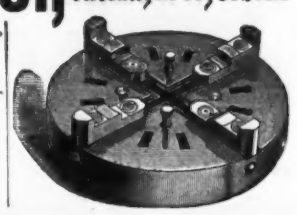

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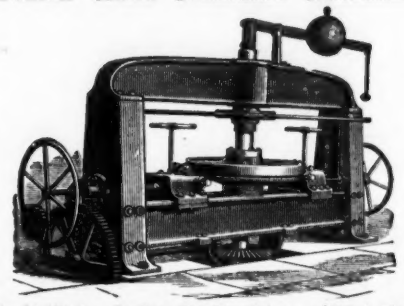

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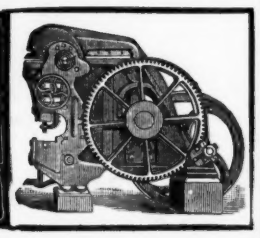

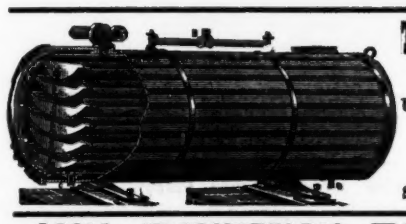

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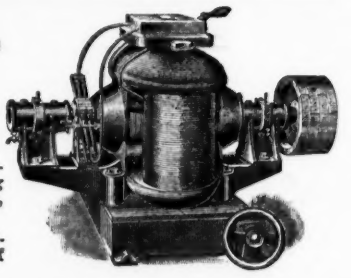

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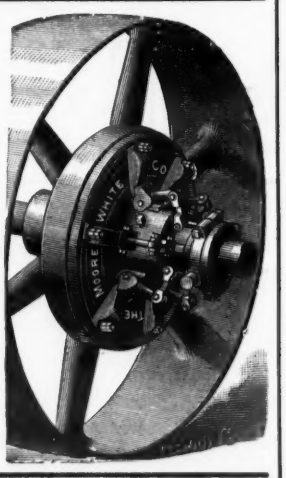

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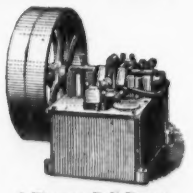

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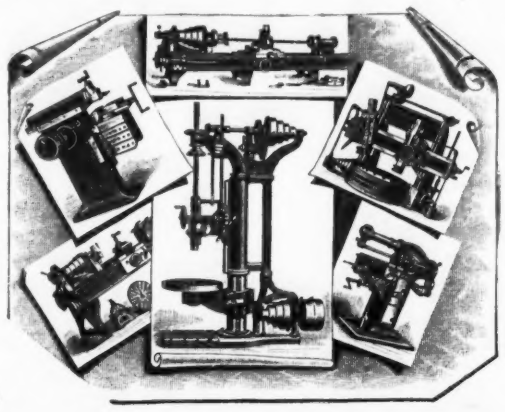

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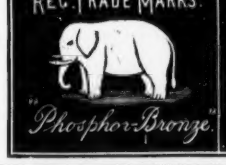

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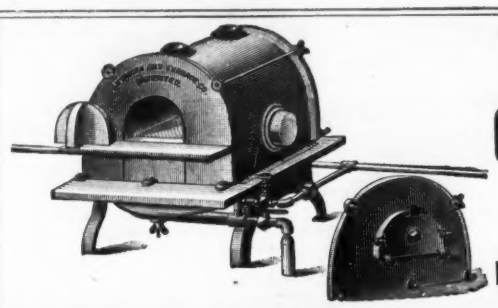

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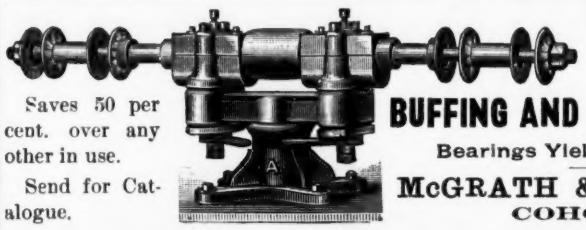

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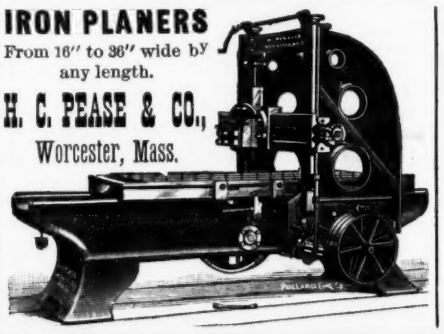

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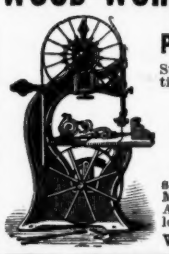

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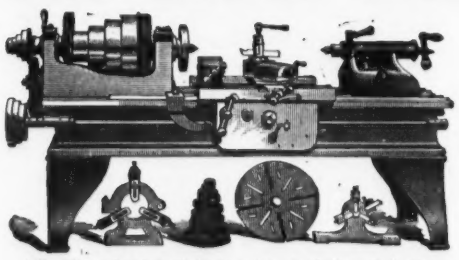

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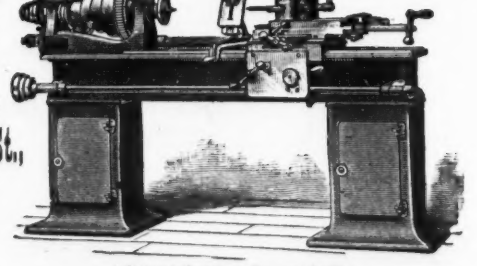

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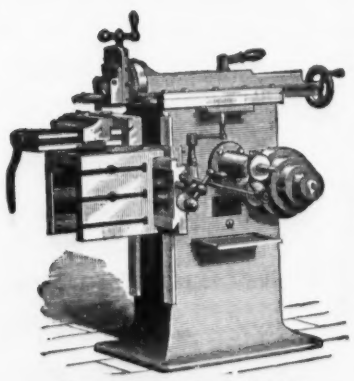

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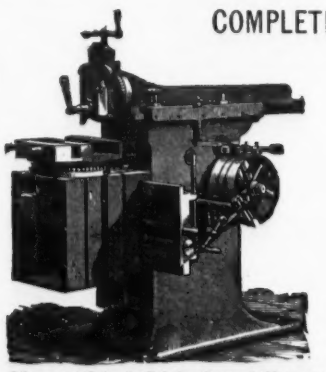

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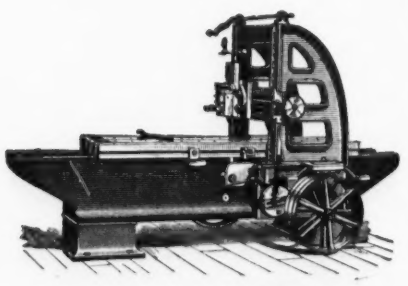

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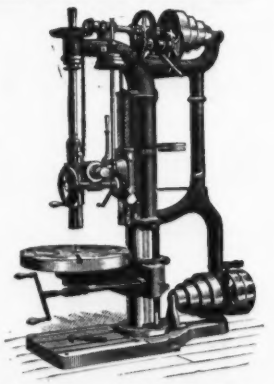

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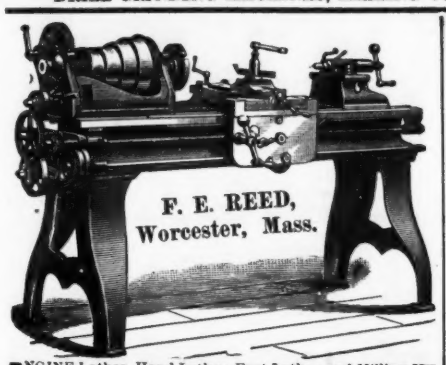

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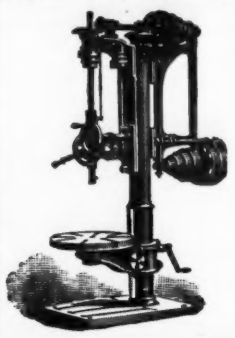

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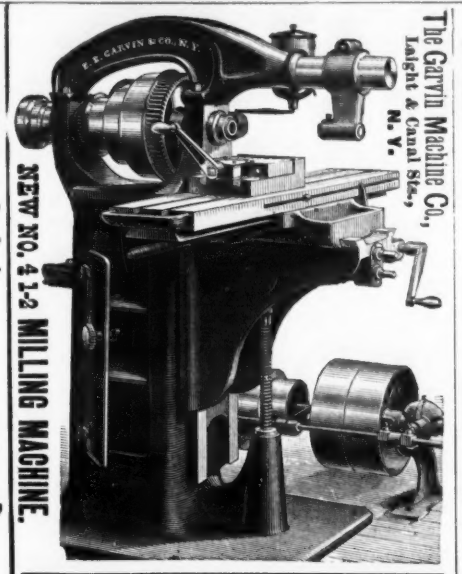

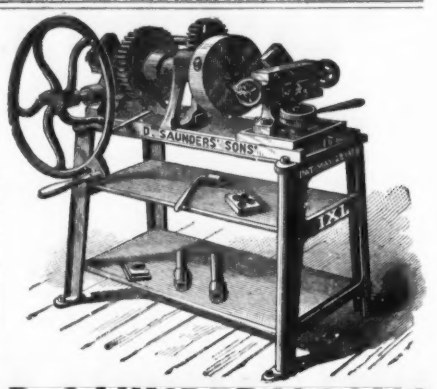

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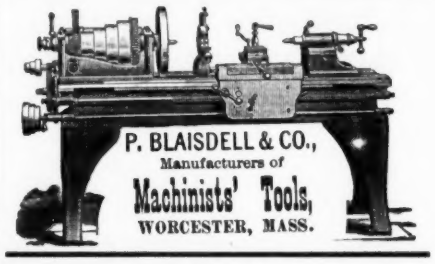

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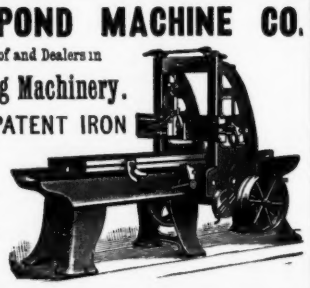

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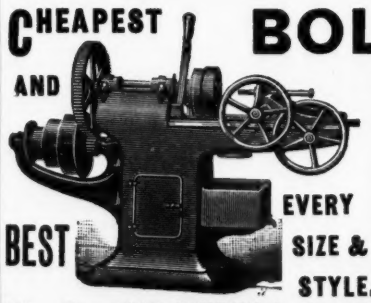

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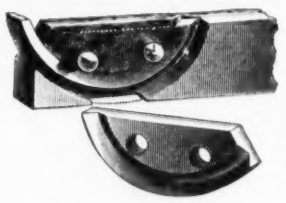

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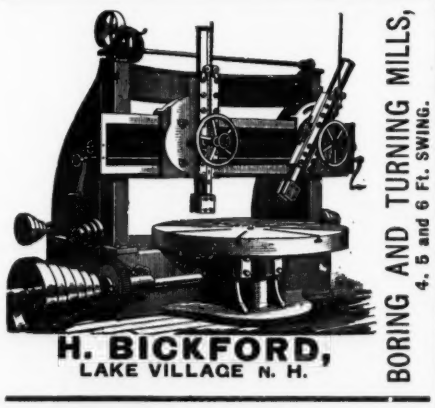

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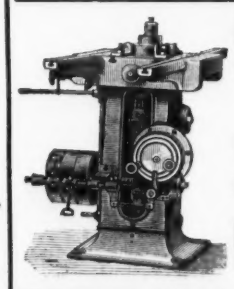

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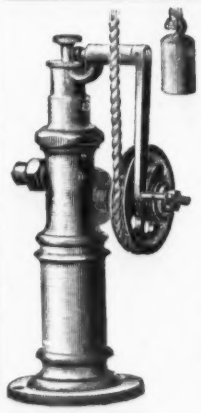

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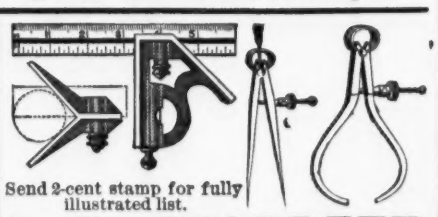

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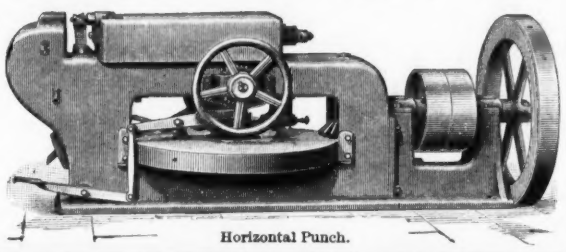
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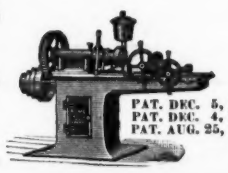
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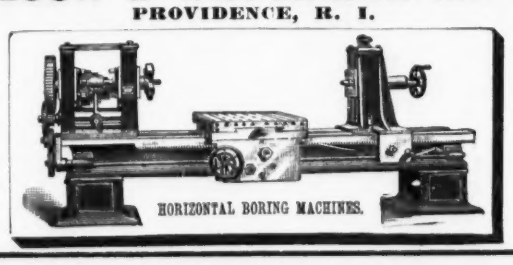
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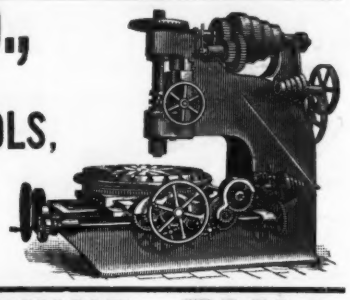

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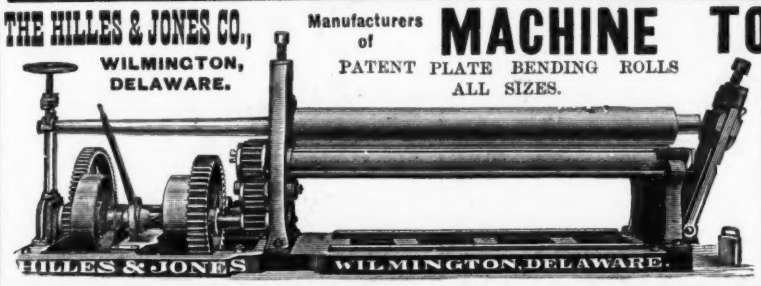

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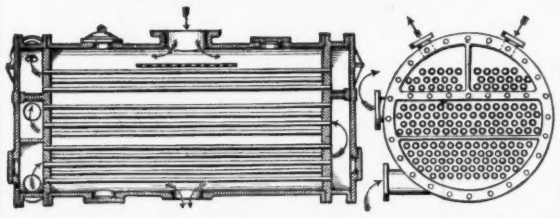
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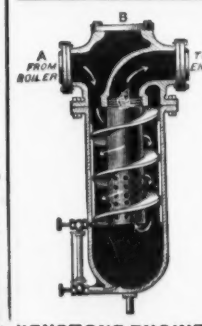

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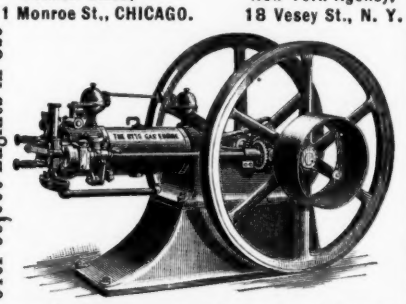

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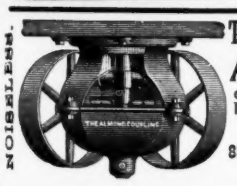

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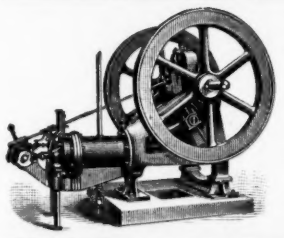

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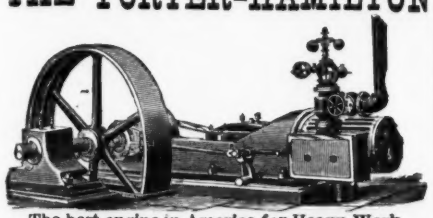

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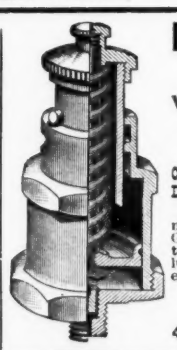

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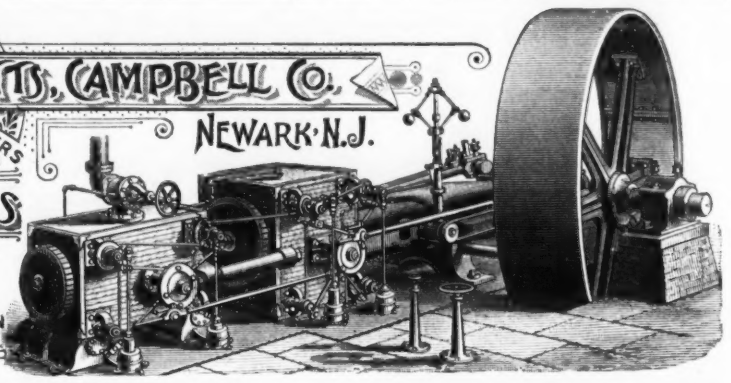

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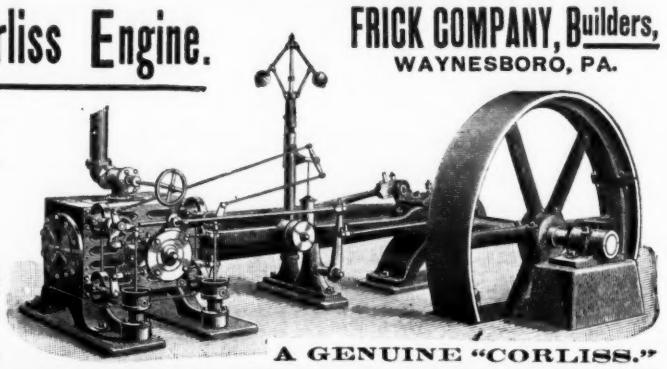

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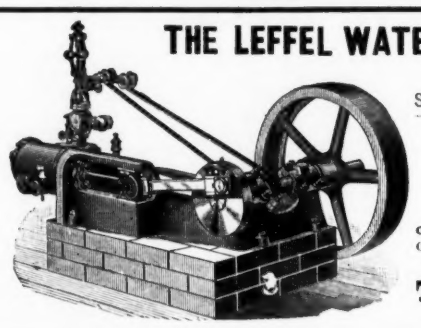

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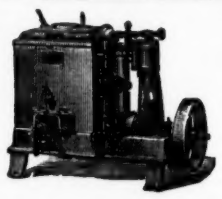

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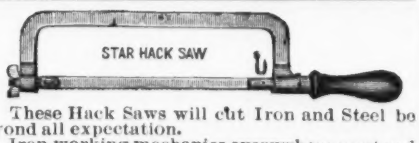

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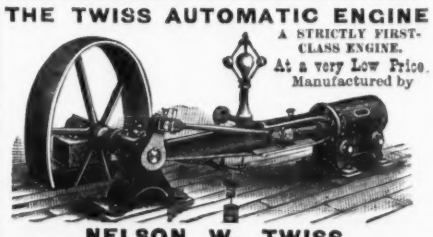

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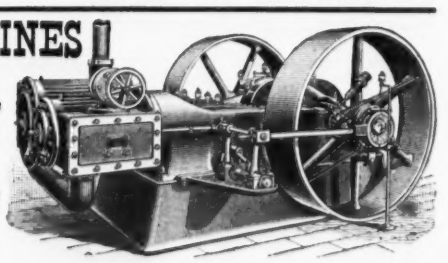

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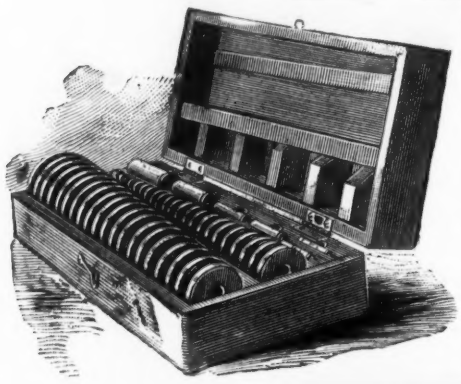

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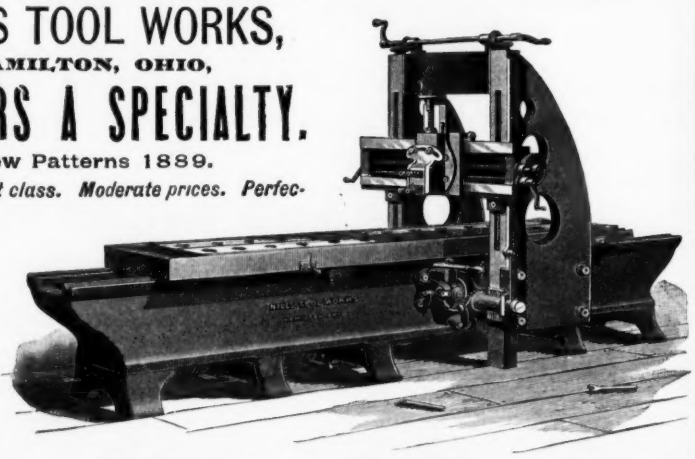

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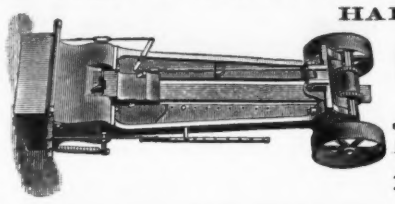

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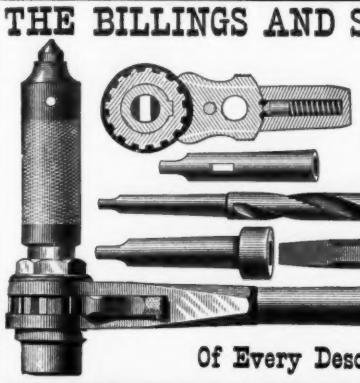

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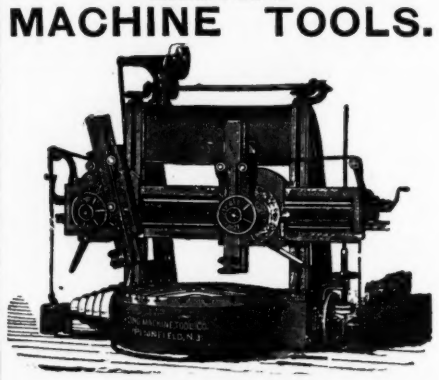

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